Vol. VI

TRANSCRIPT OF RECORD

(Pages 2495 to 3084a)

Supreme Court of the United States

OCTOBER TERM, 1943

No. 392

UNIVERSAL OIL PRODUCTS COMPANY,
PETITIONER,

vs.

GLOBE OIL & REFINING COMPANY

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SEVENTH CIRCUIT

PETITION FOR CERTIORARI FILED SEPTEMBER 28, 1943.

CERTIORARI GRANTED NOVEMBER 15, 1943.

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TRANSCRIPT OF RECORD

IN THE

Supreme Court of the United States

OCTOBER TERM, A. D. 1942.

No. 304

UNIVERSAL OIL PRODUCTS COMPANY,
Petitioner,

vs.

GLOBE OIL & REFINING COMPANY,
Respondent.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SEVENTH CIRCUIT.

THE LAWYERS CO-OPERATIVE PUBLISHING COMPANY, ROCHESTER, N. Y.
BANCROFT-WHITNEY COMPANY, SAN FRANCISCO, CAL.

IN THE

Supreme Court of the United States

OCTOBER TERM, A. D. 1942.

No. 392

UNIVERSAL OIL PRODUCTS COMPANY,
Petitioner,

vs.

GLOBE OIL & REFINING COMPANY,
Respondent.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SEVENTH CIRCUIT.

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In the

United States Circuit Court of Appeals

For the Seventh Circuit

No. 7912

UNIVERSAL OIL PRODUCTS COMPANY,
Plaintiff-Appellant,

vs.

GLOBE OIL & REFINING COMPANY,
Defendant-Appellee.

Appeal from the District Court of the United States for the Northern District of Illinois, Eastern Division.

THE BLAKELY-WARREN PRINTING COMPANY, 810 WEST JACKSON, CHICAGO

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In the

United States Circuit Court of Appeals

For the Seventh Circuit

No. 7912

UNIVERSAL OIL PRODUCTS COMPANY,
Plaintiff-Appellant,

vs.

GLOBE OIL & REFINING COMPANY,
Defendant-Appellee.

Appeal from the District Court of the United States for the Northern District of Illinois, Eastern Division.

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803—Simplified drawing of Biddison & Boyd patent prepared by Reiman	3	1231	6	2863
804—Ellis patent 1,396,999			7	3352
805—Simplified drawing of Trumble patent 1,281,884, prepared by Reiman	3	1250	6	2865
806—Alexander patent 1,407,619			7	3364
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808—Alexander patent, simplified drawing prepared by Reiman	3	1256	6	2897
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810—Excerpts from certified copy of File Wrapper of Greenstreet patent 1,740,691	3	1283	6	2899
811—Enlarged drawing of Greenstreet patent with colored lines, prepared by Reiman	3	1265	6	2953
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Zerning patent No. 1,183,266			7	3208
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Ellis patent No. 1,249,278			7	3248
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814—Prior Art Patents in File Wrapper of Egloff, 1,537,593, except those shown as separate exhibits:				
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Sketch #5. Fractionating Still #4.
Triple Tower, Successive Back Traps.

DX 675

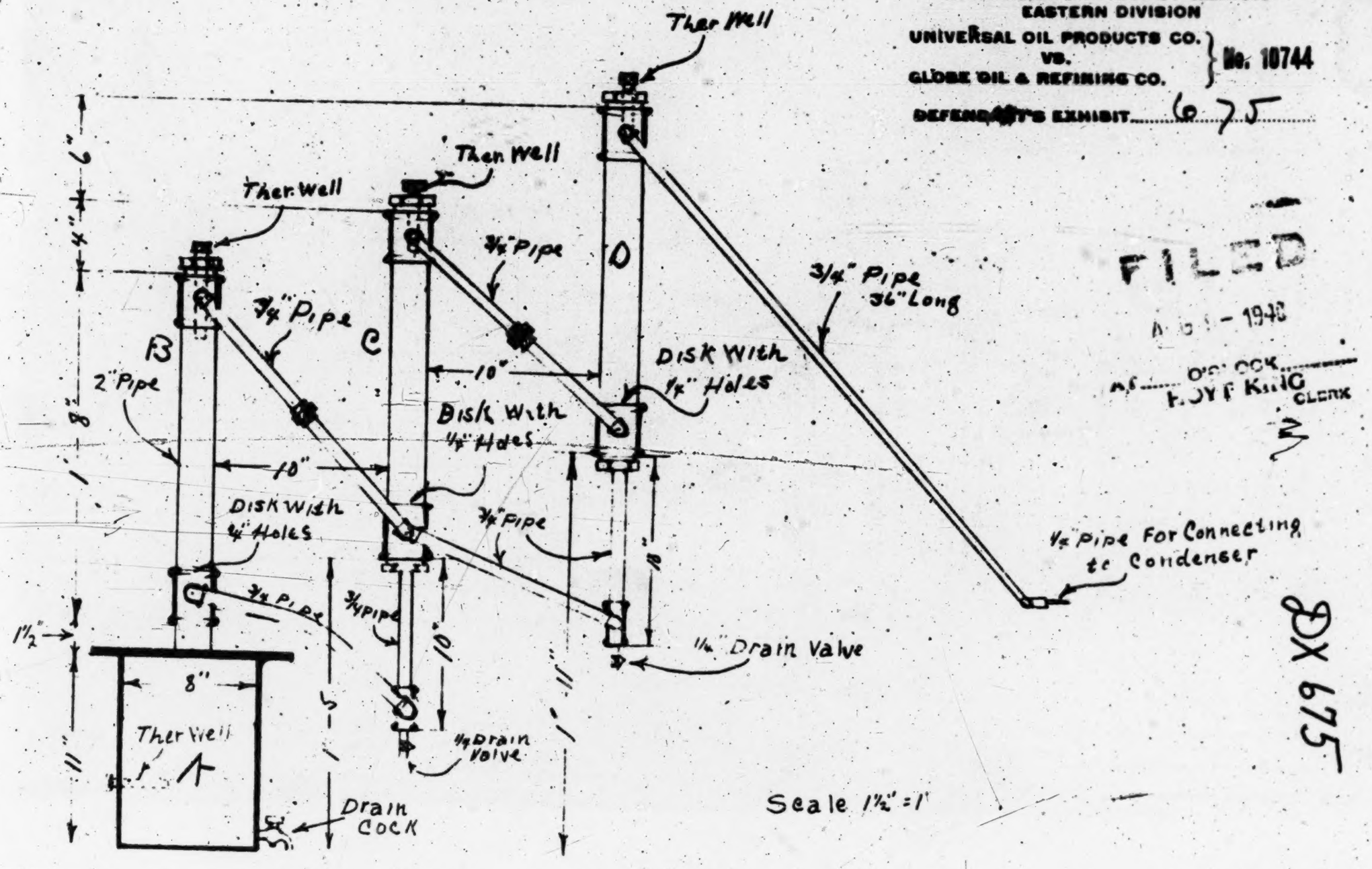
IN THE UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION

UNIVERSAL OIL PRODUCTS CO.
vs.
GLOBE OIL & REFINING CO. } No. 10744

DEFENDANT'S EXHIBIT 675

FILED
AUG 1 - 1940
O. C. COCK
CLERK

THE TEXAS COMPANY



DX 675

2495

Experiment No Coal 6
Date 5/30/17
Page 1

Experiment 8 Run 6

Reported 6/5/17

Reed & Run:

Initial Measurements
Small Supply Tank 3'-6½"
22+0
4235 Small Tank 2'-1"
Reading Tank 0-0
Distillate Tank 0-0

Time	Pump Strokes 1	Pump Strokes 2	Pressure Chs Run	Pressure Chs Coal Feed	Pressure Chs Coal Feed	Pressure Chs Drum	Pressure Chs Rec Drum	Temperatures F Degrees Coils 1	Coils 2	Coils 3	Coils 4	Coils 5	Drum	Vapor	Pyrometer F 1	Pyrometer F 2	Pyrometer F 3	Pyrometer F 4	Pyrometer F 5	Tank Gauges Supply	Tank Gauges Low	Tank Gauges Dist	Gas	P	
P.M. 6:00	29		10	10	15	15	10	245	240	520	575	505	105	900	1325	1350	920	660	13'-3¾"	0-0	0-0	0-0			730 PM flame out
6:30	32		10	10	15	15	12	250	260	805	635	425	120	900	1375	1320	1000	700	13'-3½"	—	—	0-7"			Did not ignite
7:00	33		0	0	0	0	0	260	275	505	650	440	210	925	1400	1370	1060	725	13'-2⅝"	0-0	0-0	0-2"			at 5:20 PM.
7:30	35		0	0	0	0	0	260	290	520	660	505	210	960	1425	1410	1140	750	13'-2½"	0-0	0-0	0-2"			Burning 29
8:00	35		0	0	0	0	0	260	305	540	655	510	210	980	1445	1460	1210	770	13'-1⅞"	0-0	0-0	0-2"			strokes per min
8:30	34		15	15	20	20	0	260	325	540	660	535	290	995	1435	1455	1320	780	13'-1½"	—	—	0-1"			
9:00	41		25	20	30	25	0	265	350	560	670	552	310	1020	1453	1495	1370	800	13'-½"	—	—	0-2¾"			Small supply
9:30	44		25	25	30	25	0	280	380	560	625	575	360	1040	1470	1510	1440	825	13'-0"	—	—	0-3¼"			Tank reading from
10:00	43		35	25	30	25	0	290	410	580	690	590	380	1060	1480	1540	1490	850	12'-11¾"	—	—	0-3¾"			5'-6⅞ to 5'-3¾"
10:30	37		35	30	40	35	0	450	445	595	700	600	350	1100	1500	1585	1580	870	12'-11½"	—	—	0-2⅝"			
11:00	39		50		50	45	0	460	460	600	715	625	450	1120	1510	1600	1595	900	12'-11⅛"	—	—	0-3¼"			
11:30	15		50	50	50	50	0	470	455	620	725	630	480	1110	1495	1580	1565	900	12'-10⅝"	—	—	0-2⅝"			
12:00	16		50	55	60	55	0	490	490	640	790	660	530	1150	1530	1610	1600	910	12'-10"			0-2¾"			
12:30	18		70	65	70	65	0	500	510	660	820	660	180	1160	1535	1615	1615	935	12'-10⅛"	—	—	0-2⅝"			
1:00	18		80	80	80	80	0	505	525	680	825	675	150	1170	1550	1630	1630	950	12'-10"			0-2¾"			
1:30	24		105	105	105	105	0	500	530	720	800	695	125	1200	1565	1650	1650	970	12'-9⅝"	—	—	0-2⅝"			
2:00	30		190	190	185	190	10	505	550	795	820	710	200	1200	1530	1600	1600	990	12'-9¼"	—	—	0-2¾"			
2:30	28		235	210	210	210	40	500	475	720	840	725	260	1200	1510	1580	1580	980	12'-8⅝"	—	—	1'-11"			
3:00	26		215	205	205	205	60	450	475	705	840	740	350	1190	1520	1600	1600	950	12'-7⅞"	—	—	2'-½"	75.2		
3:30	26		210	205	205	205	125	510	510	695	795	740	470	1190	1515	1600	1600	950	12'-7½"	—	—	3'-8"			
4:00	27		210	205	205	205	75	500	525	715	805	740	380	1190	1520	1600	1600	950	12'-7"	—	—	4'-5"	Gas released.		
4:30	28		210	200	210	210	55	520	530	705	815	740	405	1200	1525	1605	1610	960	12'-6½"	—	—	0-10½"	59.1		
5:00	30		230	210	225	225	50	585	600	740	815	753	490	1240	1580	1600	1595	995	10-7⅝"	1-2⅛"	0-6⅜"	2'-11"	54.2		
5:30	29		235	205	220	220	50	595	605	730	810	758	450	1240	1580	1630	1580	990	10-7¼"	1-2¼"	0-6½"	2'-7½"	53.2		
6:00	28		225	205	210	220	50	580	600	745	815	758	460	1240	1560	1605	1580	990	10-7"	1-2⅛"	0-6⅜"	0-3¼"	51.8		
6:30	27		225	205	230	230	60	575	595	746	820	754	435	1240	1575	1620	1580	990	10-6⅞"	1-2⅞"	0-6¾"	2'-3½"	56.3		
7:00	27		250	220	225	225	50	575	590	745	815	762	465	1240	1580	1620	1580	990	10-6¾"	1-3¼"	0-6¾"	3'-5½"	57.0		
7:30	24		245	210	215	215	60	555	570	730	810	761	480	1240	1580	1620	1585	980	10-5¾"	1-3⅛"	0-6⅞"	4'-9"	57.1		Gas released
8:00	24		240	210	220	220	50	575	570	725	815	742	480	1235	1570	1620	1580	980	10-5¼"	1-3⅛"	0-7"	0'-7"	52.8		
8:30	25		245	210	220	215	50	560	560	710	815	750	520	1235	1570	1600	1570	975	10-4⅞"	1-3¾"	0-7⅛"	2'-½"	57.1		
9:00	29		240	215	220	220	50	550	575	745	815	748	400	1240	1600	1640	1605	980	10-4⅜"	1-4¼"	0-7⅛"	2'-1½"	58.0		
9:30	29		215	205	210	210	60	560	570	725	810	745	490	1235	1640	1650	1610	970	10-4"	1-4¼"	0-7⅛"	4'-"	56.7		Gas released.
10:00	29		235	215	220	220	50	570	575	745	820	750	450	1240	1600	1640	1605	970	10-3⅞"	1-4¼"	0-7½"	1'-1½"	55.1		
10:30	29		235	210	215	215	50	565	575	730	815	748	430	1240	1605	1640	1580	975	10-3½"	1-4½"	0-7½"	2'-1½"	53.4		
11:00	29		235	220	220	220	60	565	575	745	815	748	450	1240	1620	1620	1580	970	10-2¾"	1-5"	0-7⅝"	3'-5"	56.4		
11:30	27		235	215	220	220	50	570	580	735	820	745	500	1240	1615	1645	1600	980	10-2½"	1-5⅛"	0-7½"	4'-7"	56.8		Gas released
12:00	28		235	215	220	220	50	560	580	745	815	750	490	1240	1575	1625	1580	980	10-2¾"	1-5⅛"	0-7½"	0'-8"	54.6		
12:30	28		240	220	220	220	50	570	580	740	815	740	500	1240	1580	1620	1580	980	10-1⅞"	1-5⅛"	0-7⅞"	2'-2¾"	54.9		
1:00	30		240	220	225	225	50	570	580	735	815	735	465	1240	1600	1635	1580	980	10-1½"	1-5⅜"	0-7"	3'-4½"	57.6		
1:30	30		245	220	225	225	55	560	570	735	820	732	475	1240	1570	1600	1565	980	10-1⅛"	1-5⅝"	0-8⅛"	4'-7¼"	52.8		Gas released
2:00	30		240	220	225	225	50	565	570	740	820	732	445	1250	1655	1620	1580	970	10-½"	1-5⅞"	0-8⅜"	0'-10"	51.3		
2:30	28		250	230	230	230	50	560	575	740	835	738	490	1260	1600	1625	1580	985	9-11⅞"	1-6⅜"	0-8½"	1'-9½"	53.4		
3:00	28		250	230	230	235	50	575	575	740	835	738	460	1245	1575	1600	1580	985	9-11⅞"	1-6⅞"	0-8⅝"	3'-8¾"	50.2		Gas released 5:05 PM when pump
														6/1	Small supply Tank				9-11⅞"	1-9¼"	0-8¾"				
														4	Tank reading				9-11⅞"	1-9⅞"	0-9⅛"				
														4235	6/2	Feed Tank			6-6⅞"						
															6/1	Small supply Tank			2-9⅛"						
6:30 PM																						4'-4½"			Clock down at 5:00 P.M.
																									Gas released

	35		0	0	0	0	0		260	290	520	660	505	710	960	1425	1410	1140	750	12-2½	0-0	0-0	0-2½			
	35		0	0	0	0	0		260	305	520	665	510	710	980	1445	1440	1210	770	12-7½	0-0	0-0	0-2			
	40		15	15	20	20	0		260	325	540	660	535	790	995	1435	1455	1320	780	13-1½	—	—	0-2			
	41		25	10	30	25	0		245	350	540	675	550	770	1020	1452	1485	1370	800	13-4½	—	—	0-2½			
	44		25	25	30	25	0		320	330	560	675	575	760	1060	1470	1510	1440	825	13-9"	—	—	0-2½			
	41		35	25	30	25	0		340	410	580	680	590	780	1080	1480	1520	1490	850	14-11½"	—	—	0-2½			
	39		35	30	40	35	0		450	475	585	700	600	750	1100	1500	1585	1560	870	14-11½"	—	—	0-2½			
11.00	37		50	50	50	45	0		460	460	600	715	625	650	1120	1510	1600	1595	900	14-11½"	—	—	0-2½			
11.30	15		50	60	50	50	0		470	455	620	725	630	780	1110	1495	1580	1565	900	14-10½"	—	—	0-2½			
12.00	16		50	55	60	55	0		490	490	640	790	660	730	1150	1530	1610	1600	910	14-10½"			0-2½			
12.30	18		70	65	70	65	0		620	510	660	820	760	780	1160	1535	1615	1615	935	14-10½"	—	—	0-2½			
1.00	18		80	80	80	80	0		505	525	680	825	675	750	1170	1550	1630	1630	950	14-10½"			0-2½			
1.30	19		105	105	105	105	0		500	530	730	800	695	725	1200	1565	1650	1650	970	14-9½"	—	—	0-2½			
2.00	30		190	190	185	190	10		505	550	795	850	710	800	1200	1530	1600	1600	990	13-9½"	—	—	0-2½			
2.30	30		235	210	210	210	40		600	475	760	850	725	760	1200	1510	1580	1580	980	12-8¾"	—	—	1-11"			
3.00	26		215	205	205	205	60		650	475	705	830	760	350	1190	1520	1600	1600	950	12-7½"	—	—	2-4½"	75.2		
3.30	26		220	205	205	205	125		610	610	695	795	760	470	1190	1515	1600	1600	950	12-7½"	—	—	3-8"			
4.00	27		210	205	205	205	75		500	525	715	805	700	380	1190	1520	1600	1600	950	12-7"	—	—	4-5"	Gas relieved		
4.30	28		210	200	210	210	45		600	630	705	840	760	405	1200	1525	1605	1610	960	12-6½"	—	—	0-10½"	59.1		
5.00	26		230	210	225	225			615	530	725	805	768	380	1200	1530	1610	1620	970	12-6⅛"	0-4½"	—	1-11"			
5.30	26		200	200	205	200	50		540	548	690	795	725	530	1200	1530	1610	1615	960	12-5½"	0-4½"	—	3-7"	57.2		
6.00	26		200	195	200	200	50		540	550	715	800	742	460	1200	1530	1610	1610	965	12-5½"	0-4½"	—	4-1"	Gas relieved		
6.30	27		210	200	205	200	60		640	554	715	810	761	495	1205	1540	1620	1620	970	12-4⅞"	0-4½"	—	0-7½	64.2		
7.00	28		200	190	195	196	50		545	535	695	800	748	450	1200	1545	1620	1620	960	12-4⅜"	0-4⅞	—	2-0	57.9		
7.30	28		225	220	220	220	50		635	560	740	820	745	320	1205	1526	1640	1640	970	12-4	0-5	—	2-7½			
8.00	29		235	220	225	225	50		546	550	720	815	745	405	1210	1540	1610	1610	970	12-3⅞	0-5⅛	—	3-3"	53.7	Gas relieved	
8.30	28		300	242	230	241	45		535	558	725	820	747½	440	1200	1530	1620	1615	970	12-3½	0-5¼	—	0-7"	59.0		
9.00	28		290	243	247	247	95		550	560	730	815	750	490	1210	1530	1620	1605	970	12-3"	0-5⅜	—	2-8"	60.2		
9.30	30		295	226	227	227	55		560	570	715	805	760	537	1210	1530	1605	1605	970	12-2½"	0-5⅜	—	4-1"	59.3	Gas retained	
10.00	30		225	205	207½	207½	70		560	570	715	805	770	510	1210	1535	1600	1600	965	12-2"	0-5⅛	—	4-10½"	59.7		
10.30	30		200	195	195	195	55		545	560	710	805	745	526	1200	1540	1620	1620	970	12-1⅝"	0-4⅞	—	4"	60.1		
11.00	31		210	200	200	200	50		560	570	705	795	745	530	1200	1535	1605	1610	965	12-1⅜"	0-4⅞	—	4-1½"	57.3		

Poor riding 29 strokes per min

Small supply Tank shut from 6⅞ to 5-3¼"

Gas relieved

Gas relieved

Experiment No
Dale 5/31/17 and
Page 2 6/1/17

Time	Feed Worker Dumbo 1	Feed Worker Dumbo 2	Pressures Chs Feed	Pressures Chs Coal Front	Pressures Chs Coal Back	Pressures Chs Drum	Pressures Chs Rec Drum	Temperatures F Degrees Coils 1	Coils 2	Coils 3	Coils 4	Coils 5	Temperatures F Degrees Drum	Temperatures F Degrees Vapt	Pyrometers 1	Pyrometers 2	Pyrometers 3	Pyrometers 4	Pyrometers 5	Land Gauges Supply	Land Gauges Flow	Land Gauges Distilled	Barometer	Gravity Sample	Remarks
11:30	30		215	195	200	210	50	540	565	725	815	750	370	990	1560	1620	1600	975	12-⅞	0-6¼	—	3-8½	49.0	15" Small supply tank changed pressure 2-¾ to 2-16 in 5 min as 2 and or 24 1.07 Gallons 2.16 Gal while pump was running 30 strokes per minute That is 124 2.16 or 2.5 per Gallon oil per hour
12 "	30		205	170	190	190	60	555	650	695	790	745	340	1005	1650	1600	1585	965	12-¼"	0-6¾	—	5-2"	37.0	
12 Bk	29		190	175	185	175	50	560	670	710	790	745	480	1210	1570	1625	1615	965	11-11⅞	0-7"	—	8-7"	49.8	
1:00	27		190	180	182½	182½	65	545	560	715	805	745	430	1210	1580	1620	1600	965	11-11¼	0-7¼	—	1-1¾	49.7	
1:30	25		205	190	195	195	70	560	565	720	850	740	470	1215	1580	1620	1600	970	11-10⅞	0-7⅞	—	2-1¾	491	
2:00	28		300	[illegible]	236	235	60	540	570	755	830	750	320	1220	1565	1625	1600	975	11-10¼	0-7⅞	—	2-4¾	38.0	
2:30	30		300	250	255	255	75	550	560	705	820	755	490	1220	1530	1605	1595	970	10-10	0-7⅞	—	2-5½	54.5	
3:00	30		295	230	235	235	80	[illegible]	525	720	810	755	500	1215	1545	1605	1590	970	11-9⅞	0-7⅞	—	1-7½	48.4	
3 "	32		250	240	245	245	50	545	570	740	815	745	430	1215	1560	1600	1600	970	11-9⅛	0-7"		1-8¼	48.8	
4:00	32		245	230	230	230	50	525	[illegible]	725	820	733	480	1220	1530	1610	1575	975	11-8⅝	0-8¼		1-10½	48.4	Gas relieved
5:00	32		270	240	245	245	55	540	560	720	815	750	440	1220	1565	1615	1595	970	11-8	0-8⅜		0-5½	54.4	
5:30	31		[illegible]	230	230	230	55	545	556	736	810	732	375	1215	1556	1610	1600	965	11-7⅞	0-8⅜		1-11"	51.1	
6:00	30		230	205	210	210	55	540	550	705	810	735	540	1220	1545	1600	1595	970	11-7⅛	0-9"		3-12½	46.5	
6:30	30		245	220	247½	247½	55	535	570	740	825	720	400	1220	1545	1610	1600	970	11-6¾	0-9⅜		1-1"	57.8	Gas relieved
7:00	29		245	220	225	226	50	540	560	710	820	725	610	1220	1550	1625	1600	975	11-6¼	0-9¾	0-4"	1-4"		
7:30	28		220	225	230	230	50	560	565	720	825	720	610	1230	1550	1620	1600	980	11-5¾	0-10"	0-3¾	2-6"	56.7	
8:00	27		230	220	225	225	50	545	575	730	820	725	500	1230	1550	1610	1590	970	11-5¼	0-10¼	0-4"	3-9½	55.8	
8:30	31		220	210	215	220	50	555	565	725	820	730	520	1230	1535	1610	1600	970	11-4¾	0-10½	0-4¼	4-3"	53.5	Gas Out
9:00	28		210	200	205	210	50	560	560	725	815	740	525	1225	1550	1615	1600	970	11-4¼	0-10⅝	0-4⅜	1-5"	55.3	
9:30	28		210	200	205	210	60	545	560	725	815	740	[illegible]	1230	1555	1620	1600	975	11-3¾	0-10⅝	0-4½	2-6"	54.2	✓
10:00	28		220	210	215	220	60	550	570	735	825	735	460	1235	1560	1620	1600	980	11-3½	0-10⅝	0-4½	3-7"	54.3	✓
10:30	28		210	200	200	210	50	550	570	725	825	726	460	1230	1570	1610	1580	980	11-2¾	0-11⅛	0-4⅝	4-5"	54.1	Gas relieved
11:00	27		200	195	195	200	50	555	575	725	810	730	450	1230	1565	1600	1580	980	11-2¼	0-11½	0-4⅝	0-9½	55.2	✓
11:30	26		200	195	195	200	50	560	572	730	810	730	425	1230	1570	1610	1580	980	11-1⅞	0-11⅞	0-4⅞	1-6"	56.4	✓

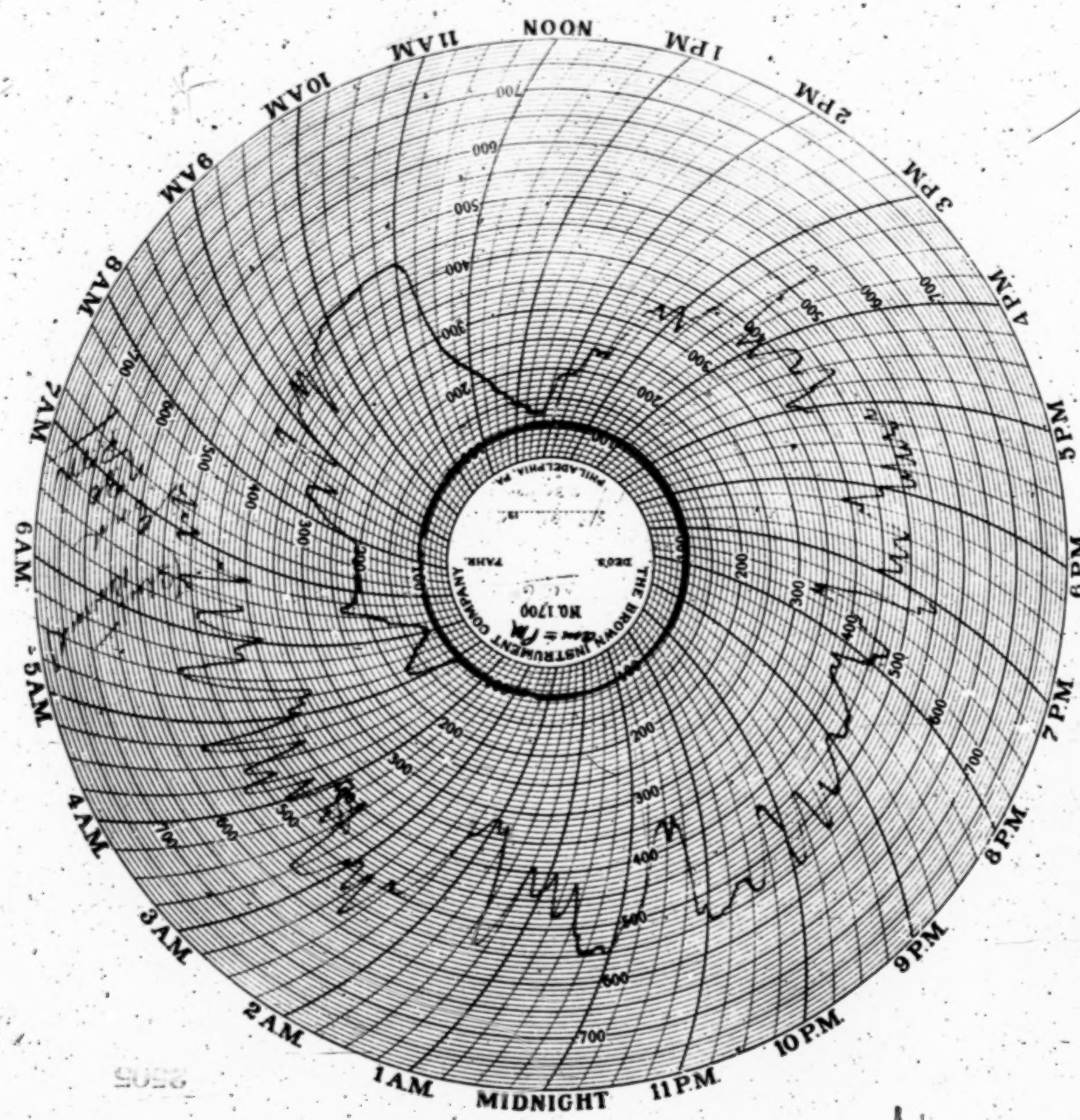
1:30	28		205	190	195	195	70		560	565	720	850	740	470	[illegible]	[illegible]	1620	1600	970	11-10½	0-7½	—	2-12	491	2.5 per Gallon oil per hour
2:00	28		300	[illegible]	235	235	60		540	570	765	830	750	320	[illegible]	1565	1625	1600	975	11-10½	0-7⅞	—	2-3½	538	
2:30	30		300	250	255	255	75		550	561	705	830	753	490	1530	1530	1605	1590	990	10-10	0-7⅞	—	[illegible]	545	Gas relieved
3:00	30		295	230	235	235	80		[illegible]	521	770	850	755	500	1545	1545	1605	1590	970	11-9⅝	0-7⅞	—	1-7½	48.4	
3:30	32		250	240	245	245	50		545	570	740	815	745	430	1515	1560	1600	1600	970	11-9⅛	0-8	—	1-8¼	48.8	
4:00	32		245	230	230	230	50		525	[illegible]	725	820	753	440	1500	1530	1610	1595	975	11-8⅝	0-8⅛	—	1-10½	48.4	Gas relieved
4:30	32		270	240	245	245	55		540	580	720	815	750	440	1520	1555	1610	1595	970	11-8	0-8⅛	—	0-5½	524	
5:00	31		[illegible]	230	230	230	55		545	586	736	810	732	375	1515	1556	1610	[illegible]	965	10-7⅞	0-8⅛	—	1-11"	511	
5:30	30		230	205	210	[illegible]	55		540	550	705	810	735	440	1500	1545	1600	1595	975	11-7⅛	0-7⅞	—	3-12½	465	
6:00	30		245	[illegible]	247½	247½	55		535	570	740	825	720	400	1520	1545	1610	1600	970	11-6¾	0-9⅛	—	1-1"	378	Gas relieved
6:30	29		245	220	225	226	50		540	560	710	820	725	[illegible]	[illegible]	1550	1625	1600	975	11-6½	0-9¾	0-4"	1-4"		
7:00	28		220	225	230	230	50		560	565	720	825	720	610	1530	1550	1620	1600	980	11-5¾	0-10"	0-3¾	2-6"	56.7	
7:30	34		230	220	225	225	50		545	575	730	820	735	580	1520	1550	1610	1590	970	11-5½	0-10¼	0-4"	3-0½	558	
8:00	31		225	210	215	220	50		555	565	705	820	730	[illegible]	1500	1535	1610	1600	970	11-4¾	0-10¼	0-4¼	4-3"	53.5	Gas Out
[illegible]	[illegible]		210	200	205	210	60		560	560	725	815	740	[illegible]	1525	1550	1615	1600	990	11-4¼	0-10⅝	0-4⅜	1-5"	553	
9:00	31		210	200	205	210	60		545	560	725	815	745	[illegible]	1530	1555	1620	1600	975	11-3¾	0-10⅜	0-4½	1-6"	554	✓
9:30	28		220	210	215	220	60		550	570	735	822	735	460	1535	1560	1620	1600	980	11-3½	0-10⅜	0-4½	3-7"	543	✓
10:00	28		210	200	200	210	50		550	570	725	822	736	460	1530	1570	1610	1580	980	11-2¾	0-11⅛	0-4⅜	1-5"	541	Gas relieved
10:30	27		200	195	195	200	60		555	575	725	810	730	450	1530	1565	1600	1580	980	11-2½	0-11½	0-4⅜	0-9½	554	✓
11:00	26		200	195	195	200	50		560	572	730	810	730	445	1530	1570	1610	1580	980	11-1⅞	0-11⅞	0-4⅜	1-4"	564	✓
11:30	26		200	195	195	200	50		550	565	720	800	740	405	1530	1575	1630	1590	980	11-1½	1-½"	0-4⅜	1-3½	559	✓
12:00	24		195	190	190	195	50		560	575	735	810	740	430	1520	1570	1610	1600	980	11-1⅛	1-⅞	0-4⅜	3-4"	573	✓
12:30	28		200	198	200	200	50		545	560	720	820	735	460	1520	1590	1610	1595	980	11-⅞	1-1⅝	0-4⅞	3-10"	60.1	✓
1:00	26		210	205	210	210	50		560	568	720	820	750	470	1530	1600	1650	1600	980	11-3⅛"	1-⅞	0-5"	4-9"	585	Gas relieved
1:30	25		220	210	210	210	50		570	575	735	820	744	465	1530	1570	1610	1590	980	10-11⅝"	1-½"	0-5¼	0-10½	573	✓
2:00	26		205	200	200	200	50		570	575	740	818	736	450	1530	1580	1600	1570	980	10-11⅜	1-⅝	0-5⅛	1-7"	529	✓
2:30	21		205	205	205	205	50		570	576	738	[illegible]	740	460	1530	1590	[illegible]	1600	985	10-11	1-¾	0-5⅜	1-7"	535	✓
3:00	23		200	200	200	200	[illegible]		575	575	735	810	744	480	1530	1590	1620	1610	990	10-10⅝	1-1"	0-5⅛	3-6½	550	✓
3:30	23		200	195	200	200	50		575	578	735	806	740	480	1530	1560	1620	1580	990	10-10¼	1-[illegible]	0-5¼	4-5"	552	✓ Gas relieved
4:00	23		210	210	210	210	50		575	585	740	810	750	[illegible]	1530	1570	[illegible]	1570	990	10-9⅞	1-1⅛	0-5¼	1-11½	554	✓
4:30	23		205	200	[illegible]	200	50		575	576	730	810	750	470	1535	1575	1610	1580	990	10-9⅞	1-1⅛	0-5¼	[illegible]	559	✓
5:00	[illegible]		195	[illegible]	200	200	50		575	580	740	820	[illegible]	535	[illegible]	[illegible]	1620	1595	985	[illegible]	[illegible]	[illegible]	3-5"	582	

Experiment No 8 Cont 6
Date 6/1/17
Page 2

6-1-17
5:30 a.m.
Small supplement
Charge of Powder 2 lbs
2 10 dia 5 grooves
1 # 63 1 1/4 x 1/4
1 # 35 Cotton Waste 1/20
Total gas heavy 10 lbs
Gun gas per minute
21 shots per minute

2503

Time	Pump Strokes 1	2	Pressures Lbs Pump	Col Front	Col Back	Drum	Receiver	Temperatures F Degrees Coils 1	2	3	4	5	Drum	Water Drum	Pyrometer 1	2	3	4	5	Tank gauge 12x10 Liffey	Low	Dead Ht	Gasometer	Gas Sample	Remarks
5:30	21		200	205	205	205	50	X	575	575	740	815	750	460	1440	1585	1600	1595	985	10'-8 3/8"	1'-2"	0'-6"	4'1"	56.6	✓ Gas rel'd.
6:00	22		200	200	210	210	50		575	580	730	820	755	450	1450	1600	1630	1600	1000	10-8 3/8	1-2 1/8"	0'-6"	0-2	55.7	
6:30	24		195	195	205	205	50		582	590	740	818	752	500	1440	1570	1600	1580	995	10'-8 1/8"	1'-2 1/8"	0'-6 1/8"	2'-7"	55.5	✓
7:00	23		200	195	205	205	50		584	600	740	818	753	490	1440	1590	1600	1595	995	10-7 7/8	1-2 1/8	0'-6 1/8	2-11"	54.2	✓
7:30	23		195	195	200	200	50		575	575	730	810	738	450	1440	1580	1620	1580	990	10-7 7/8	1-2 1/4	0'-6 1/8	2-2"	53.2	✓ Gas rel'd.
8:00	24		225	205	210	210	50		580	600	745	816	758	460	1440	1560	1605	1580	990	10-7"	1-2 3/8	0'-6 3/8	0-8 3/4	51.8	✓
	24		225	205	230	230	60		575	595	746	820	754	430	1440	1575	1620	1580	990	10-6 7/8	1-2 7/8	0'-6 3/4	2-3/4	56.3	✓
9:00	27		250	220	225	225	50		575	596	745	815	752	465	1440	1580	1620	1580	990	10-6 7/8	1-3 1/8	0'-6 3/4	3-5 1/2	57.0	✓
9:30	24		245	210	215	215	60		555	570	736	810	751	480	1440	1580	1620	1585	980	10-5 1/2	1-3 1/8	0'-6 7/8	4-9	57.1	✓ Gas relieved
10:00	29		240	210	215	215	50		575	570	725	816	742	480	1435	1570	1620	1580	980	10-5 1/8	1-3 1/8	0-7"	0-2	52.8	✓
10:30	29		245	205	215	215	50		560	560	710	815	730	480	1435	1570	1600	1570	975	10-4 7/8	1-3 3/4	0-7 1/8	2-4"	57.1	✓
11:00	29		240	215	220	220	50		550	576	745	815	748	480	1440	1600	1640	1605	980	10-4 1/8	1-4 1/4	0-7 1/8	2-1 1/2	58.0	✓
11:30	25		215	205	210	210	60		560	570	725	810	745	490	1435	1640	1650	1610	970	10-4"	1-4 1/4	0-7 1/8	4-1"	56.7	✓ Gas relieved.
12:00 Noon	29		235	215	220	220	50		570	575	745	820	750	450	1440	1600	1640	1605	970	10-3 7/8	1-4 1/4	0-7 1/8	1-1 1/2	53.1	✓
12:30	29		235	210	215	216	50		565	575	730	816	745	470	1440	1605	1640	1580	975	10-3 1/4	1-4 1/2	0-7 1/2	2-1 1/2	53.4	✓
1:00	29		235	220	220	220	60		560	575	745	815	748	450	1440	1620	1620	1580	970	10-2 1/4	1-5"	0-7 5/8	3-5"	56.4	✓
1:30	27		235	216	220	220	50		570	580	735	820	745	500	1440	1615	1645	1600	980	10-2 1/4	1-5 1/8	0-7 1/2	4-7"	55.8	✓ Gas relieved
2:00	28		235	215	220	220	50		560	580	745	815	751	490	1440	1575	1625	1580	980	10-1 3/4	1-5 1/8	0-7 1/2	0-3"	54.6	✓
2:30	28		240	220	220	220	50		570	580	740	820	740	500	1440	1580	1620	1580	980	10-1 1/8	1-5 1/4	0-7 7/8	2-2 3/4	54.9	✓
3:00	30		240	220	225	225	50		570	584	736	820	735	465	1440	1600	1635	1580	980	10-1"	1-5 3/8	0-7"	3-4 1/2	57.16	✓
3:30	30		245	220	225	225	55		560	580	735	820	732	475	1440	1570	1600	1565	980	10-0	1-5 5/8	0-8 1/8	4-7 1/4	52.8	Gas relieved
4:00	28		245	220	225	225	50		565	580	740	820	732	470	1450	1555	1620	1570	970	10-0 1/2	1-5 5/8	0-8 1/4	0-10	51.3	
4:30	28		250	230	230	230	50		565	575	740	820	738	490	1460	1600	1625	1570	985	9 11/16	6	0	1	53.4	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2 PM
3 PM
4 PM
5 PM
6 PM
7 PM
8 PM
9 PM
10 P.M.
11 P.M.
MIDNIGHT
1 AM
2 AM
3 AM
4 AM
5 AM
6 AM
7 AM
8 AM
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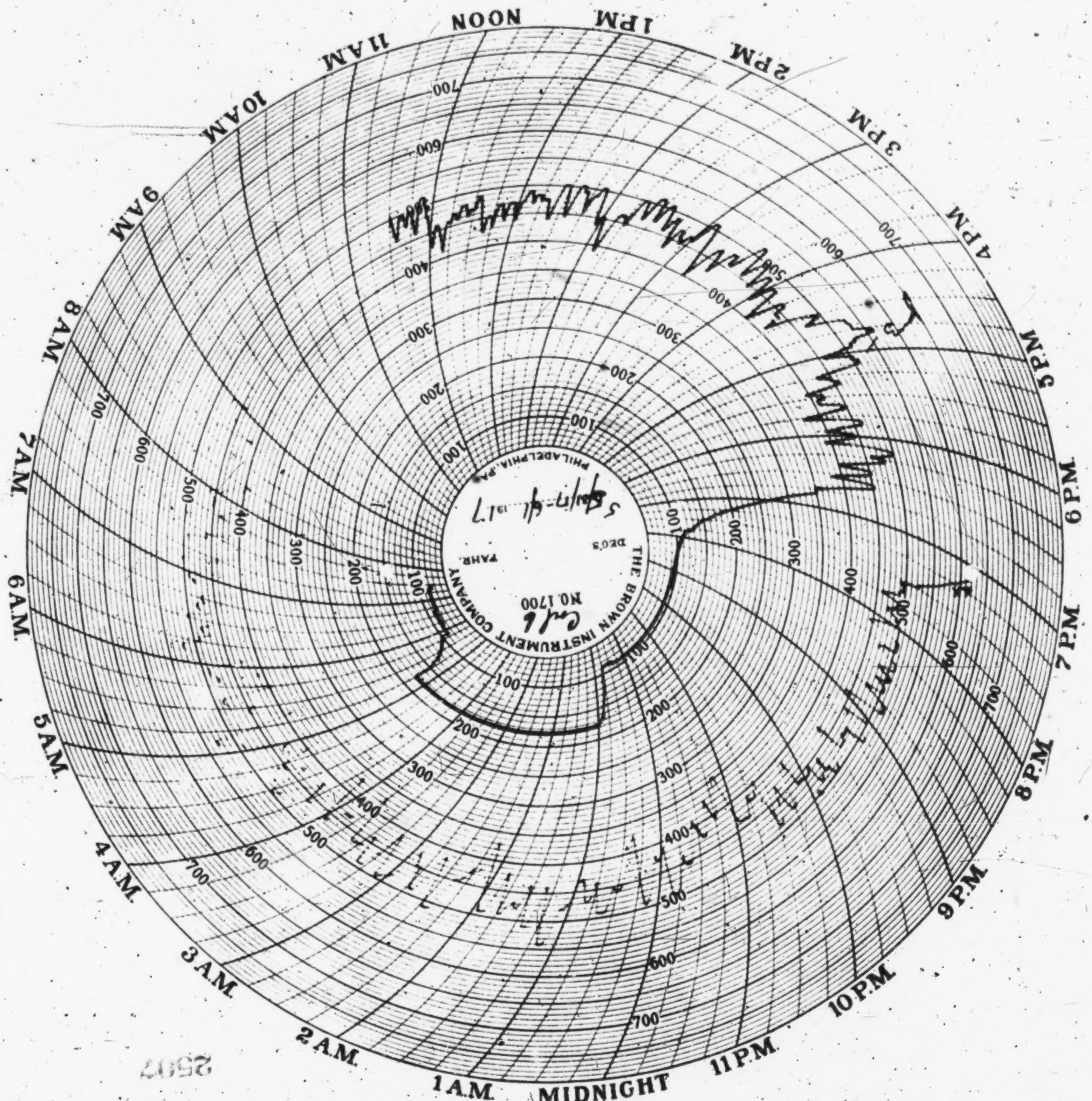
11 AM
100
200
300
400
500
600
700
THE BROWN INSTRUMENT COMPANY
PHILADELPHIA, PA.
No. 1700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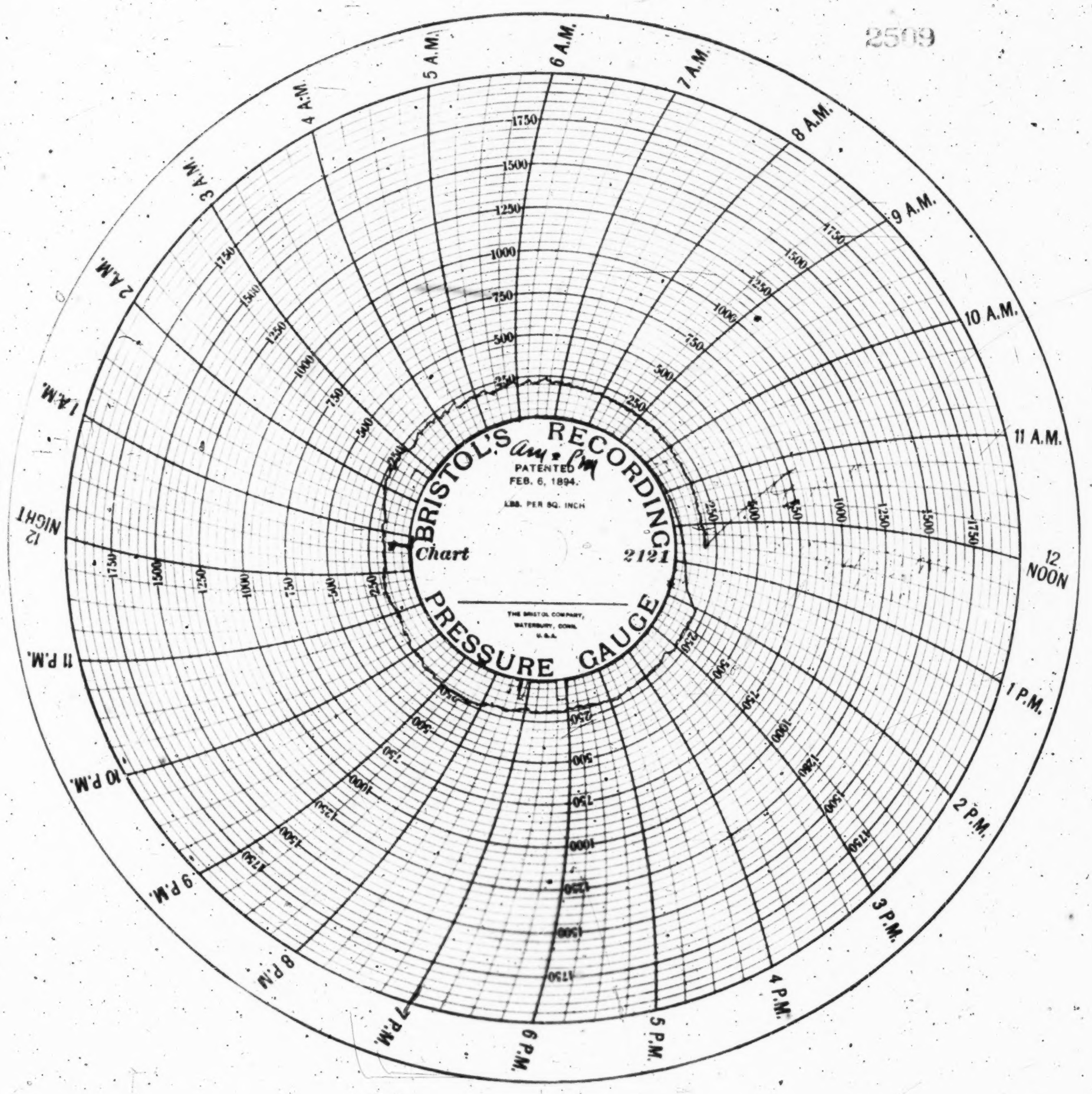
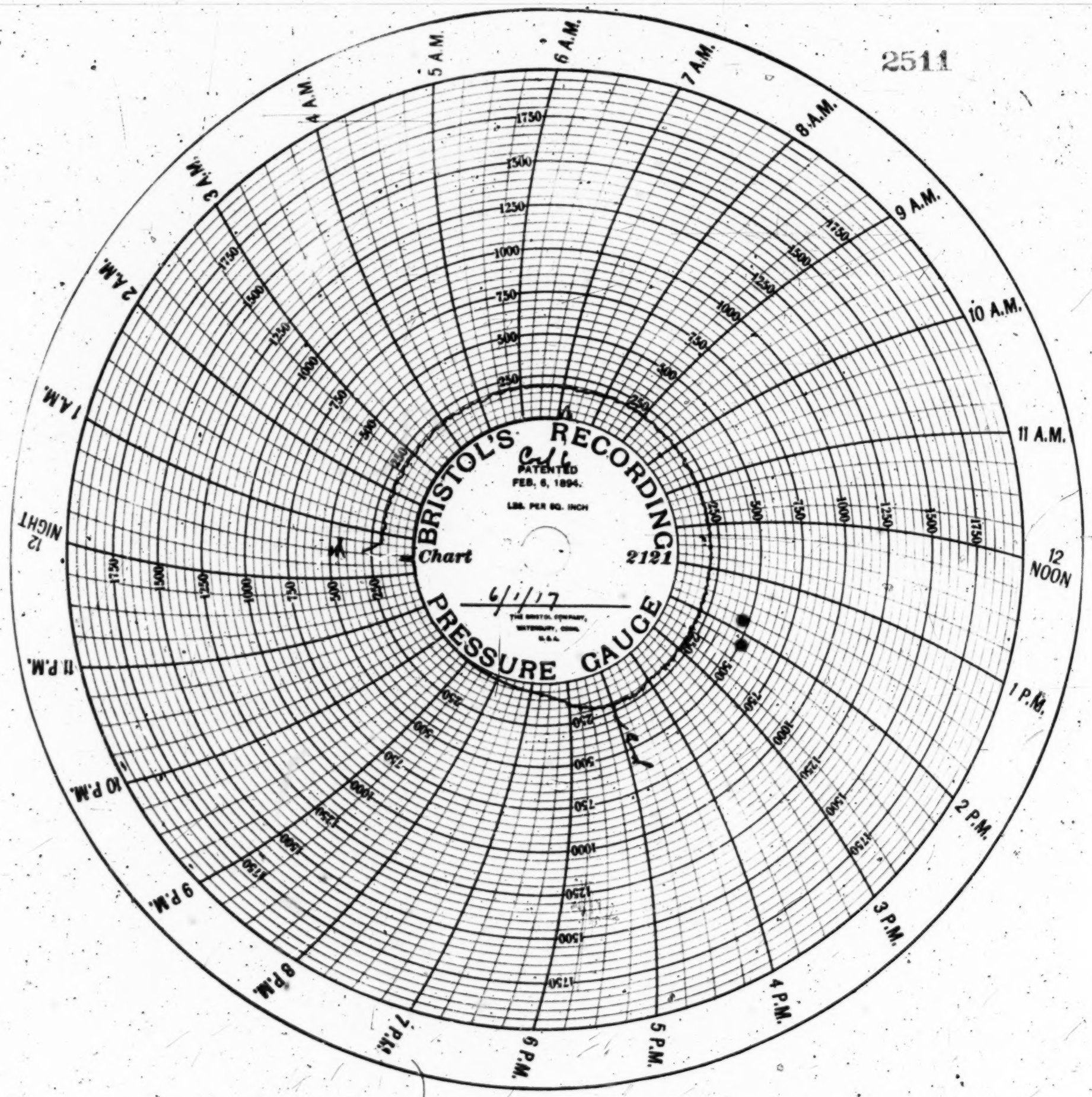
THE BROWN INSTRUMENT COMPANY
PHILADELPHIA, PA.
No. 1700
TAHR
DEC'S

2509


BRISTOL'S RECORDING
PATENTED
FEB. 6, 1894.
LBS. PER SQ. INCH
Chart
2121
THE BRISTOL COMPANY,
WATERBURY, CONN.
U.S.A.
PRESSURE GAUGE
12 NIGHT
1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
6 A.M.
7 A.M.
8 A.M.
9 A.M.
10 A.M.
11 A.M.
12 NOON
1 P.M.
2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
9 P.M.
10 P.M.
11 P.M.
250
500
750
1000
1250
1500
1750

2511


BRISTOL'S RECORDING
PATENTED
FEB. 6, 1894.
LBS. PER SQ. INCH
Chart
2121
6/1/17
PRESSURE GAUGE
12 NIGHT
1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
6 A.M.
7 A.M.
8 A.M.
9 A.M.
10 A.M.
11 A.M.
12 NOON
1 P.M.
2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
9 P.M.
10 P.M.
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250
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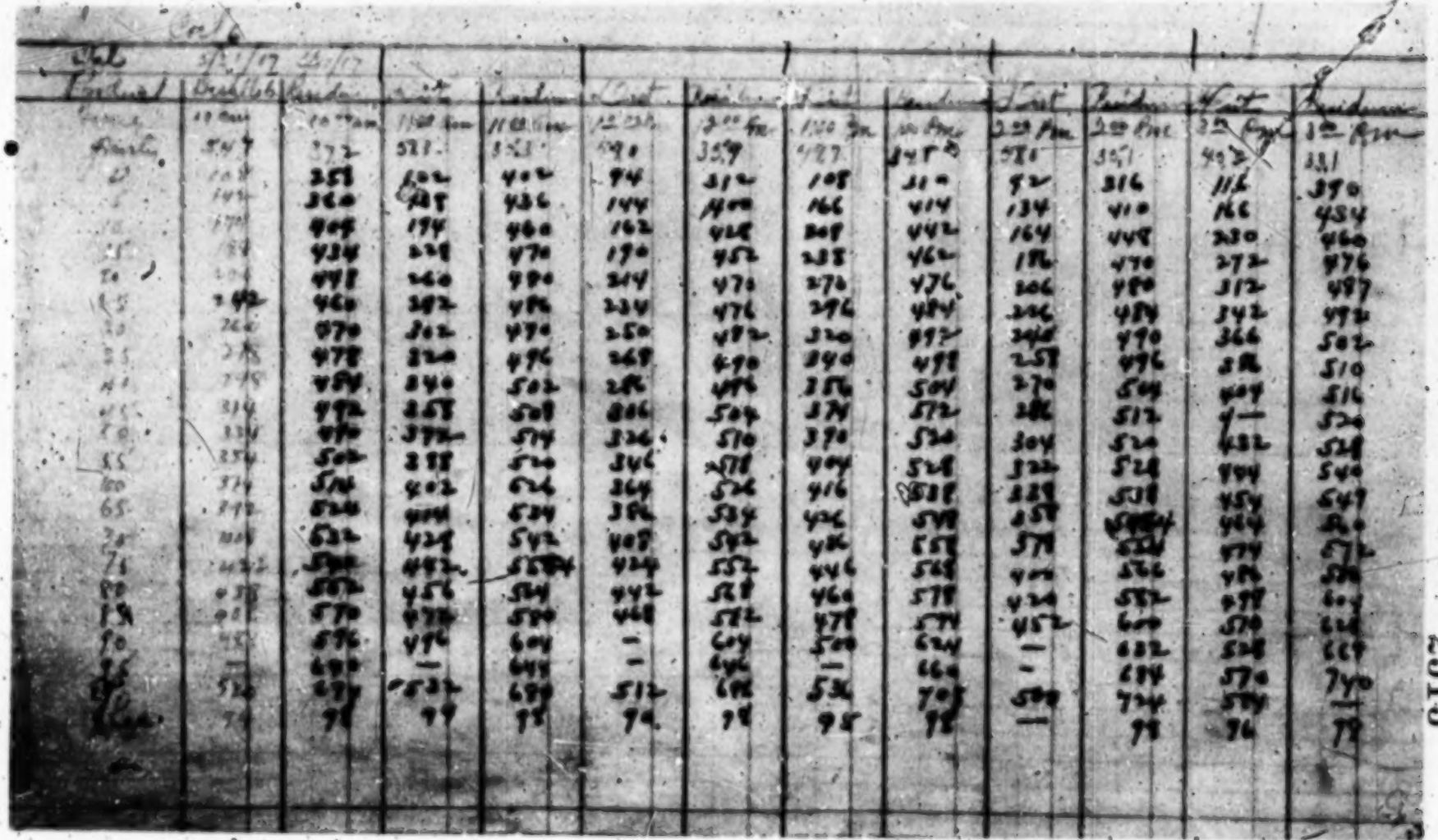
750
1000
1250
1500
1750

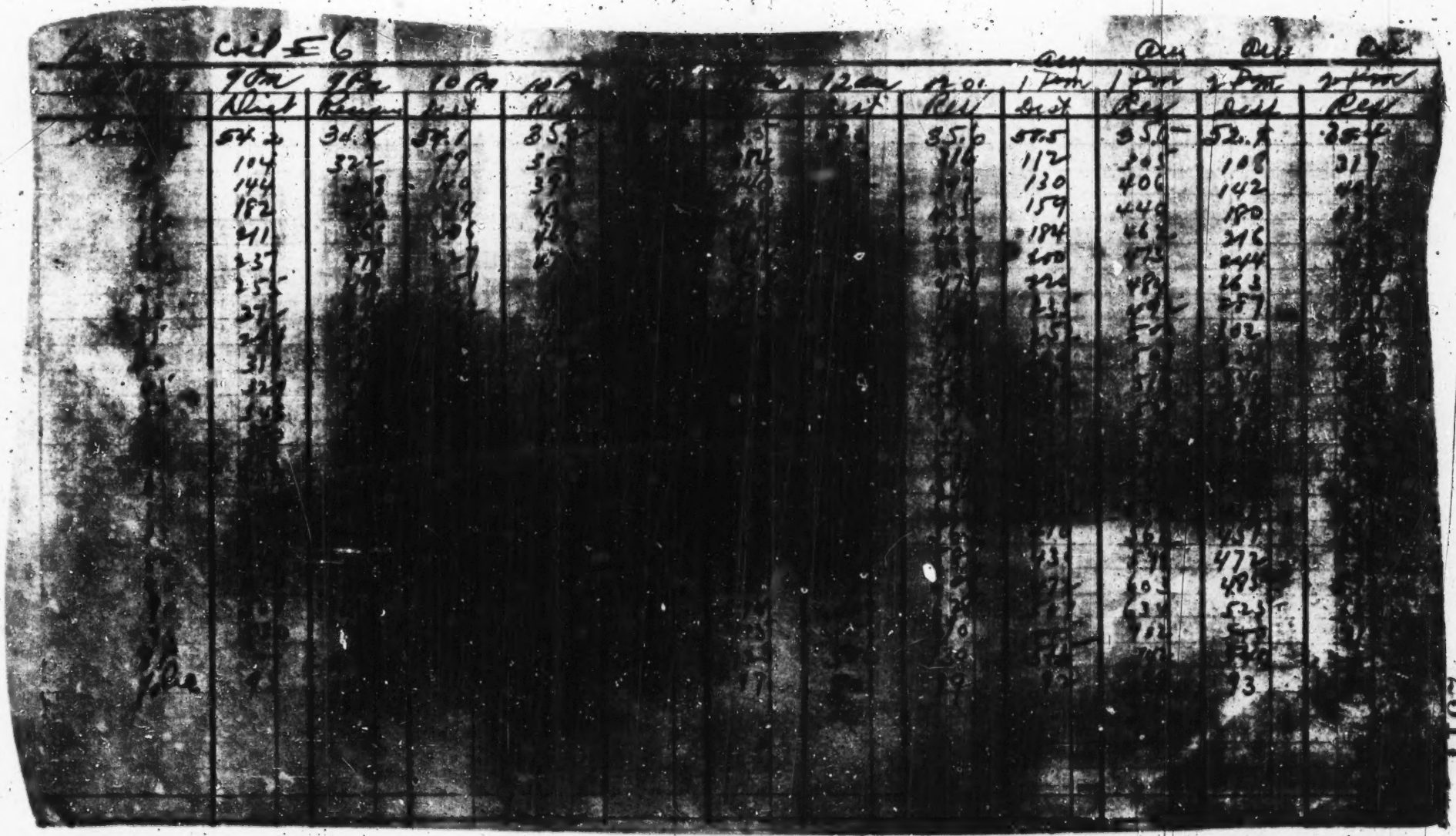


Coil 6

4:00 P.M.	4:30 P.M.	5:00 P.M.	5:30 P.M.	6:00 P.M.	6:30 P.M.	7:00 P.M.	7:30 P.M.	8:00 P.M.	8:30 P.M.
4	34.1	32.1	35.1	37.8	39.2	56.7	86-5	63.5	23.
80	280	137	292	102	259	110	279	120	31
182	410	180	404	126	370	134	450	140	39
212	440	204	438	150	434	160	450	170	47
258	458	230	460	174	446	182	460	176	51
272	474	252	470	198	458	210	470	190	53
316	488	280	481	216	472	230	492	194	54
340	494	360	490	234	488	244	494	214	57
360	504	320	498	252	498	257	498	224	58
380	512	358	505	280	512	270	502	234	60
394	518	363	511	298	520	284	510	244	62
414	526	402	518	312	532	294	520	254	64
426	532	416	526	330	542	304	530	264	66
440	540	432	534	344	550	314	540	274	68
450	550	452	542	360	560	324	550	284	70
462	560	468	550	374	570	334	560	294	72
472	570	478	558	390	580	344	570	304	74
479	582	488	568	404	592	354	580	314	76
507	602	506	580	420	604	364	590	324	78
538	634	542	592	438	618	374	600	334	80
550	692	560	610	458	630	384	610	344	82
	720		624	480	644	394	620	354	84
	99		99	99	99	99	99	99	99

10

2515



2517

6-1-17 Form 6

Temp of	7 A.M.	10 A.M.	7 P.M.	10 P.M.	7 A.M.	10 A.M.	7 P.M.	10 P.M.	7 A.M.	10 A.M.	Highest	Lowest
6-1-17	3rd	3rd	4th	4th	5th	5th	6th	6th	7th	7th	7th Cop	8th Cop
Standard	55.0	85.1	55.4	84.1	57.7	84.8	53.7	84.9	54.2	84.5	87.8	34.6
10	112	406	107	360	98	384	96	378	98	370	396	328
5	164	450	148	416	132	408	136	396	142	410	450	408
10	188	476	174	448	160	448	162	440	174	440	488	440
15	218	478	200	464	188	462	190	460	206	462	488	460
20	246	484	227	472	208	472	214	472	236	474	496	474
25	262	493	250	482	226	482	234	482	252	482	510	482
30	277	560	266	492	242	490	252	490	268	490	510	490
35	300	508	281	500	260	496	272	496	290	498	514	496
40	322	514	298	512	274	502	288	504	308	504	522	502
45	338	520	315	521	292	512	304	510	326	512	532	510
50	356	528	331	530	308	520	322	516	344	518	532	518
55	380	540	350	536	328	524	340	524	360	526	542	524
60	396	544	376	542	346	536	358	534	378	534	548	532
65	418	560	392	550	366	546	376	544	396	544	554	544
70	430	569	411	563	386	558	394	552	410	552	560	552
75	450	581	427	574	408	566	417	564	426	564	572	568
80	472	596	444	590	428	578	430	576	440	580	588	580
85	512	624	474	612	458	602	454	592	460	602	610	606
90	530	674	510	633	498	632	496	626	486	638	648	642
95	—	724	—	704	—	702	—	696	—	706	706	706
99	530	—	510	732	516	738	518	724	516	740	744	732
Total	72	98	92	76	92	98	92	98	94	98	94	72

2519

6-1-17 Coil 6

Start	570	346	568	341	470	349	551	349	564	349	546	340
1		322	44	340	94	329	100	288	96	280	98	276
5	142	414	186	472	136	416	148	396	146	370	158	400
10	166	442	162	488	156	448	176	434	172	430	180	436
15	190	456	190	454	182	460	204	458	198	454	204	462
20	214	470	210	472	204	472	224	474	220	470	226	472
25	234	480	234	482	222	482	246	484	246	482	252	480
30	252	488	252	490	238	490	264	490	262	484	274	488
35	270	494	266	500	256	498	280	498	278	494	290	496
40	286	500	284	508	274	506	302	506	294	502	308	502
45	304	506	306	516	290	514	320	514	314	510	328	508
50	326	516	322	522	304	522	338	520	330	516	344	516
55	342	524	342	530	324	528	358	528	346	524	364	524
60	360	532	362	538	346	536	376	538	360	534	384	532
65	378	540	380	546	366	546	396	546	382	542	402	542
70	402	550	398	554	388	556	412	556	398	552	414	552
75	424	564	420	570	408	570	430	566	416	562	432	566
80	440	550	440	586	432	584	448	552	430	550	450	582
85	472	602	466	606	460	606	468	608	454	606	472	600
90	512	680	500	634	472	634	500	632	494	622	506	636
95	—	704	—	708	—	708	—	714	—	714	—	700
61	520	—	520	—	520	—	520	—	508	—	512	—
Place	91	—	92	—	93	—	92	—	92	—	92	—

2521

Page 2

6-1-17 Coil 6

Time	5th Pm	5th Pm	6th Pm	6th Pm	6th Pm	6th Pm	6th Pm	6th Pm	7th Pm	7th Pm	8th Pm
0	816	35-0	678	353	502	351					
5	96	289	116	148	113	308					
10	152	386	162	398	160	395					
15	186	426	207	429	194	480					
20	220	458	242	458	240	460					
25	250	479	270	477	272	474					
30	278	478	296	454	302	482					
35		495	316	493	324	492					
40				502	348	499					
45				509	362	506					
50				514	385	513					
55					404	520					
60					420	524					
65					432	537					
70					446	541					
75					462	554					
80					469	558					
85					492	565					
90					505	604					
95					520	643					
100					538	694					
EP	546				550	706					
1 Rise	72				72						

2523

Project 31.08 7.77 3.886 Ja. 1, 1964

Extension 18 Line C

2525 37

Date 1917	Time	Charge gallons	Discharge Pipeline gallons	Pipeline gpd	Drainage gallons	Drainage gpd	Ja. Eq. Ft.
5/30/17	6 PM	11.655					
5/31/17	6:30 PM	15.540					
	7 PM	19.425					
	7:30 PM	3.885					
	8:00	11.655					
	8:30	27.195					
	9:00	23.310					
	9:30	11.655					
	10:00	11.655					
	10:30	7.770					
	11:00	7.770					
	11:30	5.540					
M.M	12:00	7.770					
5/31/17	12:30	7.770					
	1:00	7.770					
	1:30	11.655					
	2:00	15.540					37.64
	2:30	23.310					
	3:00	15.540				75.2	2.06
	3:30	11.655					31.91
	4:00	15.540					14.72
	4:30	15.540				59.1	17.19
	5:00	11.655	169.68				20.51
	5:30	11.655	5.04			57.2	20.32
	6:00	15.540	0.00				16.70
	6:30	11.655	10.08			59.2	12.32
	7:00	15.540	5.04			57.9	27.1
	7:30	11.655	15.12				12.28
	8:00	11.655	10.08			53.4	31.92
	8:30	11.655	10.08			59.6	11.46
	9:00	15.540	0.00			60.0	29.4
	9:30	11.655	0.00			59.3	32.21
	10:00	11.655	15.12	27.1		54.7	2.46
	10:30	11.655	5.04			51.1	43.37
	11:00	15.540	14.28	35.3		51.3	15.56
		466.20	459.24				341.25

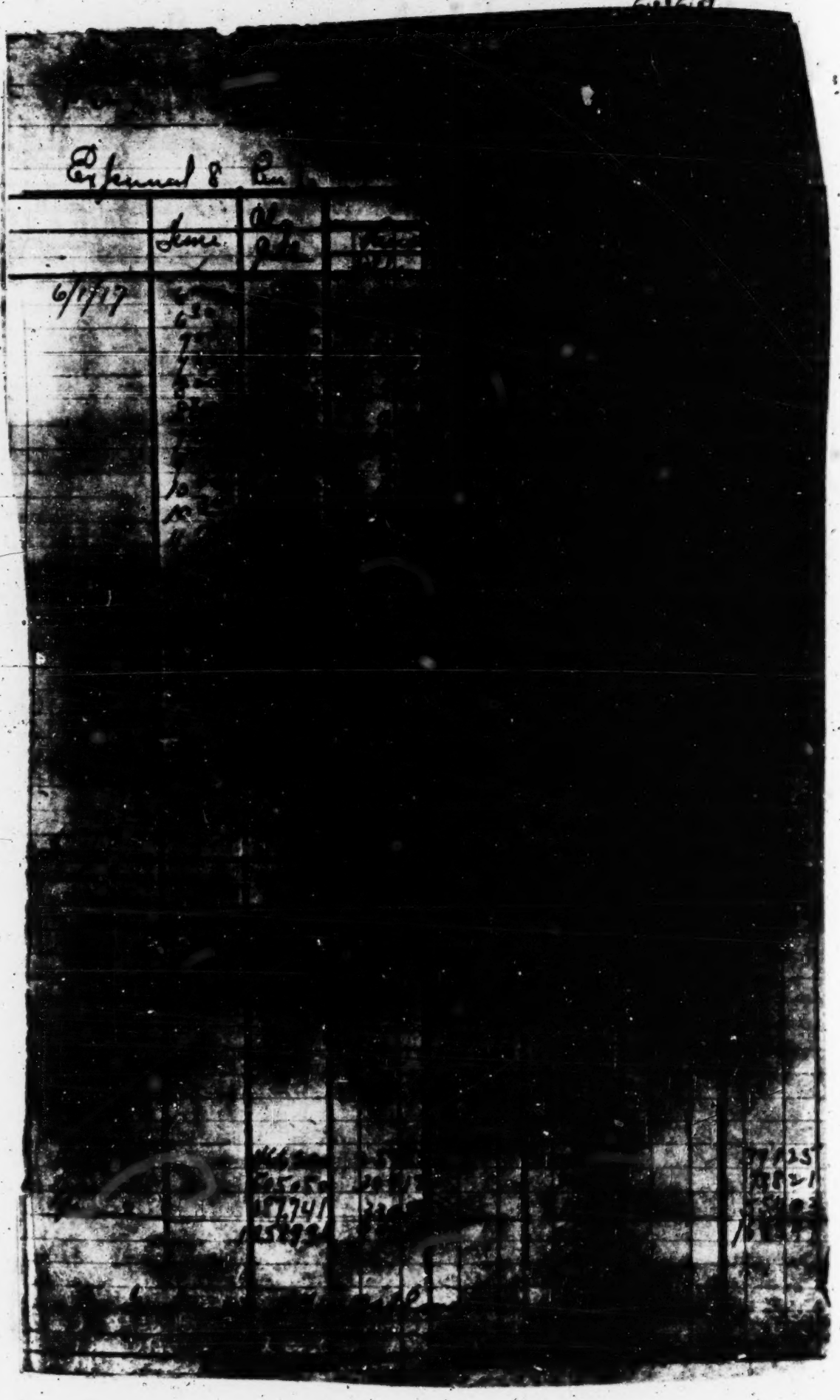
5 Cm 6-1-17

2527

Page 4 — 3210 31.08 7.77 3.885 — qa 1" = 19.54 / 1" = 1.637

Experiment 18 Run 6

	Time	Check gallons	Burbage Receiver gallons	Burbage Receiver Δt	Burbage Discharge gallons	Burbage Discharge Δt	Gas Δ p/k
5/31/17	11:30 AM	15.540	12.60			49.0	11.46
	12:00 noon	11.655	0.00	359		57.0	28.69
	12:30 PM	11.655	8.82			49.8	11.44
	1:00	19.425	9.24	348		49.7	11.85
	1:30	11.655	5.04			49.1	19.33
	2:00	19.425	17.64	351		58.0	11.27
	2:30	7.770	0.00			54.5	38.03
	3:00	11.655	0.00	321		49.4	32.33
	3:30	15.540	2.78			49.8	20.44
	4:00	15.340	31.50	348		49.4	42.96
	4:30	19.425	5.04			51.4	9.00
	5:00	11.655	0.00	351		51.1	28.64
	5:30	11.655	21.00			46.5	25.37
	6:00	15.540	5.46	352		57.8	17.19
	6:30	15.540	10.50				26.19
	7:00	15.540	10.50	355	15.960	56.7	22.91
	7:30	15.540	10.50		5.04	55.8	25.37
	8:00	15.540	10.50	336	15.12	53.5	7.00
	8:30	15.540	5.04		0.00	55.3	27.83
	9:00	15.540	5.46	342	5.04	54.2	21.28
	9:30	15.540	5.04		0.00	54.8	21.28
	10:00	15.540	10.50	352	2.52	54.1	16.37
	10:30	15.540	5.46		2.52	55.2	15.55
	11:00	11.655	26.04	336	10.08	56.4	10.64
	11:30	19.425	10.50		0.00	55.7	18.82
	12:00 M	3.885	2.52	356	0.00	59.8	20.46
6/1/17	12:30 PM	15.540	2.94		0.00	60.1	9.82
	1:00	7.770	5.04	356	5.04	58.5	18.01
	1:30	15.540	5.46		10.08	57.3	17.19
	2:00	15.540	5.04	354	0.00	52.9	13.92
	2:30	11.655	5.46		5.04	53.5	19.64
	3:00	11.655	10.50	351	2.52	55.0	18.82
	3:30	11.655	5.04		7.56	55.2	17.19
	4:00	11.655	10.50	348	5.04	55.4	23.73
	4:30	7.770	10.50		.000	55.9	22.10
	5:00	15.540	5.46	348	5.04	57.7	21.28
	5:30	7.770	10.50		5.04	56.6	13.10
		505.05	309.12		145.28		738.21


External & Cu
6/1/17

2531

Summary See Fractional Distillation Folder

Yield of Products by Volume based on Charge

			Gallons	%	Gr.	
Distillate (0.8548)	Refluxed 3/4 to 637	(352.6)	209.74	16.56	601	0.853
	Absorption Refluxed		4.63	0.37	—	
	Refluxed above 374°		145.04	11.51	—	
	Run Overflowing		4.29	0.34	—	
Residue	(Residue Tank)		846.61	67.26	352	
Column	not determined					
Loss	1613.49	(Coffee)	48.59	3.86	—	
Charge						

Remarks: The Run was discontinued because of leakage in the valve on the top of the column the vapor time not right for even boiling and the heat could not be increased any more and the pressure was maintained at 5 lbs. Only the lower tube was centrigued and there contained some water on the bottom. The drum contained practically no water.

Run-No 5

Position of Thermometers in Cords. All are in front

No 1 beginning of Coil 2

No 2 End of Coil 3

No 3 beginning of Coil 6

No 4 beginning of Coil 10

No 5 beginning of Coil 14

2533

Position of Pyrometers

1 Pyrometer 1 between 1st & 2nd Row Tubes & 1st & 2nd Baffle in front part of Furnace

Pyrometer 2 between Arch & 1st Baffle (front) of Furnace

Pyrometer 3 between 1st & 2nd Baffle in middle Furnace

Pyrometer 4 between 2nd Baffle & back part of Furnace

Pyrometer 5 between 1st & 2nd Row Tubes at 1st & 2nd Baffle in rear of Furnace

Page No 6

Calibrate

Hot

Cold

Lime Stock Coal Creek Shaft

S. 37.7

St. floor 855 4 ave

	Time	Ft.	Ave	Average		Size	Gr.	
St.	11.50	192	440	456	504			
	12.31	250	440	469	510	178	531-86-50.6	51.0-86=484
	12.39	353	442	469	510	"		
	12.40	300	444	470	510	12		
	12.43	365	446	491	511	15	67 — 47.3-84 = 45.7	
	12.44	370	446	497	512	13½		
	12.48	370	448	493	514	12½		
						Totals	195	

Bottoms 477 ce 381-79-37.2

2
4
5
10
15
20
25
30
35
40

2595

30

Monday May 7 1917

Kind of oil	Container	Tare	
abs 3	steel	3 lbs ✓	
4		4 lbs	
Solvent oil abs 12 stock	?	?	2 lbs. 5:20 P.M.
Sample after bubbling abs 1.			2¼ lbs
abs 3. treated			4 lbs ✓
abs 4			2 lbs ✓
abs 5 barrel 2 stock			~~none~~ leaking
abs 7. stock 50 Naphtha	Drum I.	2 lbs ✓	8:20 P.M.
abs 5 barrel 2 stock			~~1 lb~~
abs 11 Pening stock	Barrel 2	1 ¾ lbs ✓	
abs 9	Barrel 2 stock.	1 ⅞ lbs ✓	
abs 9	Drum I 2nd 5 Gall.	3 ½ lbs ✓	
4.28.17 6 vs PM.			
abs 9	Drum 2 2nd 5 Gal	2 ½ lbs ✓	
4 28 17 10 vs P.M.			

Experiment No Cock-17 — Extension & Run 7 — Repeated

Date 6/10/17

Page 1

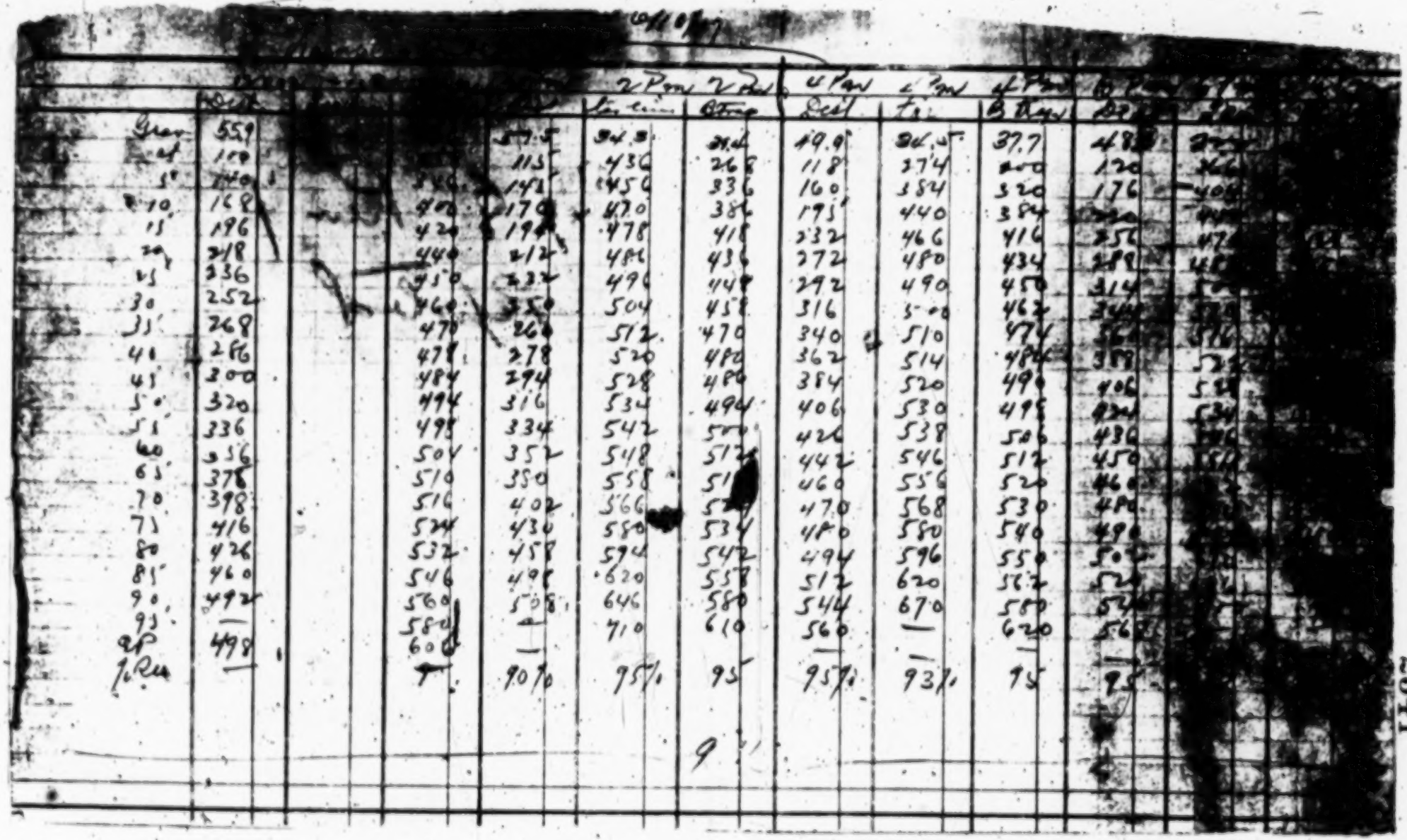
Fuel & Run

Fuel before filling 9'-9"
Fuel after filling 13'-3 3/4"
13'-3 7/8"

Small Duffle Tank 2 — 6 7/8"
Duffle Tank 18 — 2 7/8"
Fuel Tank 6'6 7/8"
Jar Tank 1.2539
Distillate Tank 0.0 — 1 — 0

Small Duffle Tank 3 — 2 1/2"
Duffle Tank 11 — 8 5/8"
Fuel Tank 6 — 5 3/8"
Jar Tank — 4"
Distillate Tank — 1 — 0

Time	Pump Strokes 1	Pump Strokes 2	Pressures Lbs Air	Pressures Lbs Cyl Head	Pressures Lbs Cyl Barrel	Pressures Lbs Pump	Pressures Lbs Receiver	Temperatures Degrees F Pyrometers 1	2	3	4	5	Pump	Vaporizer	Cocks Deg F 1	2	3	4	5	Tank Gauges Duffy	Jar	Distillate	Fuel	Quantity Duff Tank	Jar	Remarks
6/10/17																										
			16	18	20	20	0	965	1338	1420	1350	850	430	25	448	465	615	672		13-1½	0-0	0-0	0-0	—		Fire started
			30	45	45	45	0	1045	1400	1510	1480	910	323	82	460	525	630	695		13-7/8	0-0	0-0	0-0	—		at 2:03 Gyro
			180	170	170	170	50	1100	1440	1530	1510	950	310	82	440	516	780	900		13-½	0-0	0-0	0-0	—		Started charging
			200	200	200	200	50	1120	1435	1550	1570	945	645	103	410	462	765	854		12-11½	—	—	3-7"	Gasoline		Settled at 6:56 Gyro
			200	200	200	200	50	1145	1453	1570	1605	965	615	100	448	486	788	852		12-11½	—	—	4-8"	Gasoline		6/10/17 8:32 am
			190	190	190	190	50	1185	1515	1650	1680	990	590	40	476	515	740	855		12-10½	—	—	5-1"	Gasoline		Fuel Pump down
			170	170	170	170	50	1200	1525	1650	1680	995	695	280	466	505	730	865		12-10	—	—	5-8"	582		2 1/4" Stroke
			170	165	165	165	50	1210	1540	1660	1705	1000	715	420	540	542	765	885		12-10½	—	—	6-½"	Gasoline		Duffle Starter
			170	170	170	170	50	1220	1540	1660	1690	1000	720	420	572	580	752	875		12-10"	—	—	6-10"	559		
			250	250	250	250	50	1230	1545	1660	1700	1010	695	500	587	600	770	875		12-9¾	—	—	4-5½	575	Red	6/10/17
			250	250	250	250	50	1235	1540	1650	1680	1005	700	500	470	510	695	785		12-8¼	—	—	2-8"	500		
			275	250	250	250	50	1220	1540	1650	1680	1000	740	410	528	540	725	825		12-7⅞	0-	0-	3-6"	491		
			270	270	270	270	50	1235	1550	1660	1685	1005	745	445	576	570	750	840		12-7⅜	0-¾	0-4	5-4"	575	Red	55 Duffle at
			270	270	270	270	50	1240	1560	1670	1700	1010	760	490	615	615	760	849		12-7"	0-¾"	0-4½	3-2"	550	34	= 0.838 gal. per
			275	260	265	265	50	1250	1565	1675	1705	1020	770	530	485	540	710	814		12-6¾	0-¾"	0-4¾	5-2	494	Red	
			280	255	255	255	50	1240	1550	1660	1695	1010	760	480	558	565	740	830		12-6⅝	0-¾"	0-5½	2-5"	564		
			280	265	265	265	50	1245	1550	1660	1690	1015	765	500	570	580	760	835		12-6¼	0-¾"	0-5¾	6-1"	499		
			280	265	265	265	50	1250	1555	1665	1700	1020	765	500	570	585	765	835		12-6⅛	0-⅞	0-5⅞	3-2"	514		
			275	255	265	265	50	1250	1560	1660	1690	1020	770	510	578	590	765	835		12-5¾	0-1"	0-6"	5-5"	487	Red	
			270	255	260	260	50	1250	1555	1660	1690	1010	770	510	576	590	750	835		12-3½	0-1"	0-6½	3-7"	483	Red	
			260	255	260	260	50	1250	1550	1660	1690	1020	770	500	582	600	755	840		12-2⅝	0-1"	0-6¾	2-8"	486	32	
			270	255	260	260	50	1250	1550	1660	1690	1020	775	515	580	601	750	840		12-2¼	0-1⅛	0-7½	5-3"	479		
			300	255	256	260	50	1260	1556	1660	1696	1030	775	515	588	590	755	840		12-1¼	0-1¼	0-7⅞	4[illegible]	473		Run 2



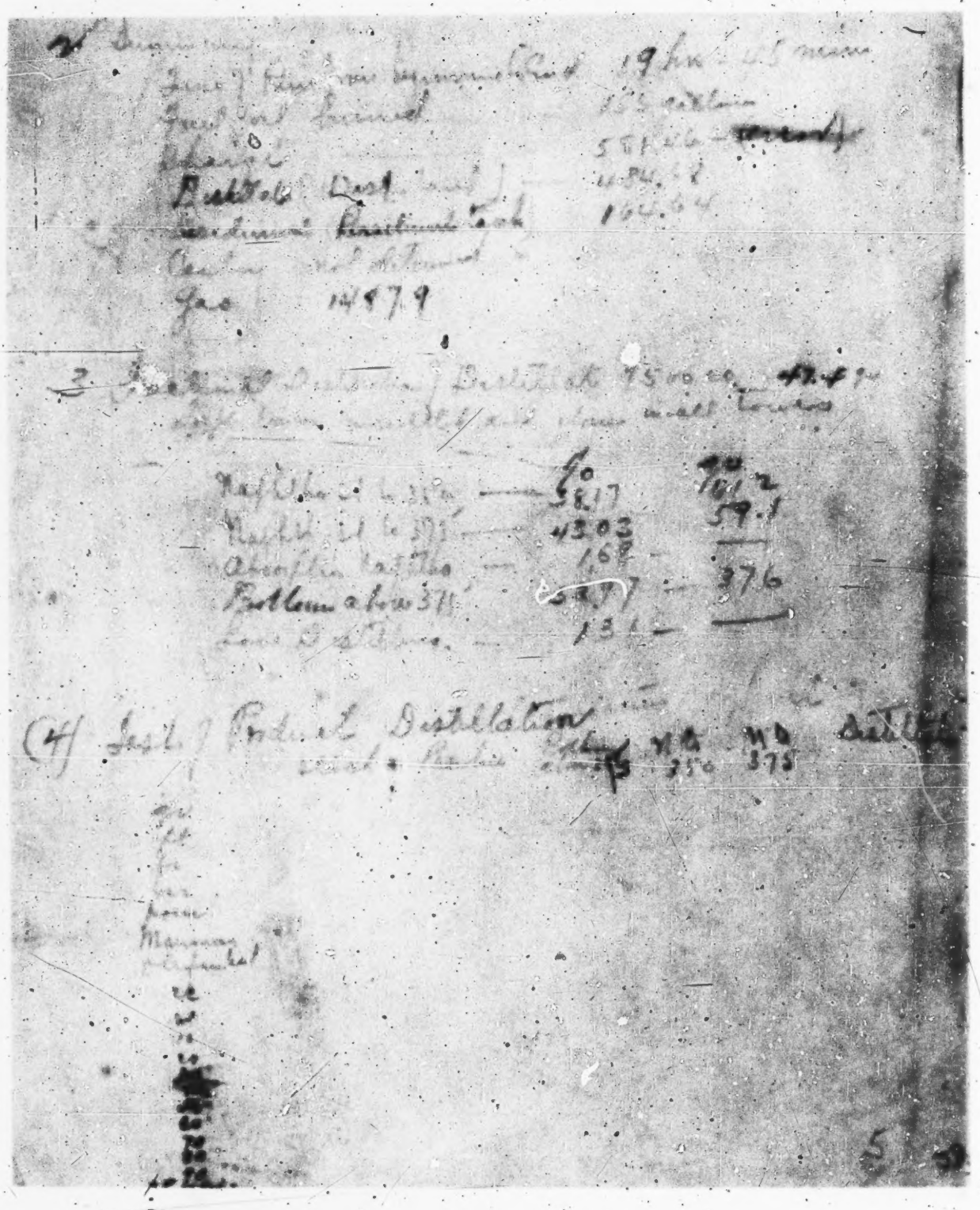
2541

9/10/17 Oil 7

Zero at Deck 4 gr

Time	500 Pm			102 Pm			Mark	Tan	Distillate
	Distillate	BJ	Tan	Distillate	BJ	Star			
9	48.3	35.3	31.3	47.2	31.2	20.2			47.4
11	126	214	270	136	214	278			
5	172	288	398	190	330	396			
10	216	410	440	226	390	438			
15	250	440	460	260	420	464			
20	284	456	484	292	446	482			
25	310	468	492	328	456	496			
30	334	478	504	350	470	504			
35	356	486	514	372	478	516			
40	380	492	520	392	488	524			
45	396	500	528	412	496	530			
50	418	508	536	430	508	536			
55	434	514	546	444	514	546			
60	448	520	556	456	520	552			
65	458	528	566	466	524	564			
70	472	536	584	478	530	580			
75	484	542	598	490	540	596			
80	498	554	614	506	550	620			
81	514	566	644	520	562	642			
90	550	582	700	556	576	700			
91	—	606	—	—	606	—			
9	560	—	—	578	—	—			
9 Rec	92	97	91	92	97	90%			

9 "



(5) Yield. Product by volume from total charge
measured in measurement. The charge
is taken as room & residue and distillate which
makes the results slightly higher than should be

		gallons	%	%
Distillate 74.65% 47.4	N.H.S. 375	208.2	32.12	59.1
	Above Distillate	9.1	1.35	
	Boiling above 375°	101.6	10.09	2.75
	Loss Distillate	6.4	0.99	
	Residuum Residual Carbon not determined Gas 1487.7 Feature	164.64	25.35	30.5

6 Remarks: The run is a discontinuous because of excessive leakage around the copper gasket at head to tower and the copper gasket around the riveted [illegible] tube. Tube retained considerable carbon on the [illegible] tubes

R [illegible]

6

Coil 7

	Stock	Stock	Distillate
Sec.	37.6	30.5	4.7 C
Flash	180	145	
fire	221	200	— 6 C
Vis	36/110	36/110	26/100
Pour	0	0	0
Manuene.			
Olefin			

Coil 7.
Upk to 375

Distillate 10% cuts
Sp 1.30
10 - 234 - 69.1
20 - 288 - 60.7
30 - 334 - 54.6
40 - 376 - 48.9
50 - 416 - 45.0
60 - 454 - 42.2
70 468 - 30.
80 492 - 38.3
90 526 - 36.7
95 556
EP 590
% 98%

2549

Form G 888 1-11-43M

	FAMILYLITE				CRYSTALITE								STOVE GASOLINE				NAPHTHA			
	Bulk	Barrels Wood	Barrels Iron	2-6 Cases	Bulk	Barrels Wood	Barrels Iron	2-6 Cases	Bulk	Barrels Wood	Barrels Iron	2-6 Cases	Bulk	Barrels Wood	Barrels Iron	2-6 Cases	Bulk	Barrels Wood	Barrels Iron	2-6 Cases

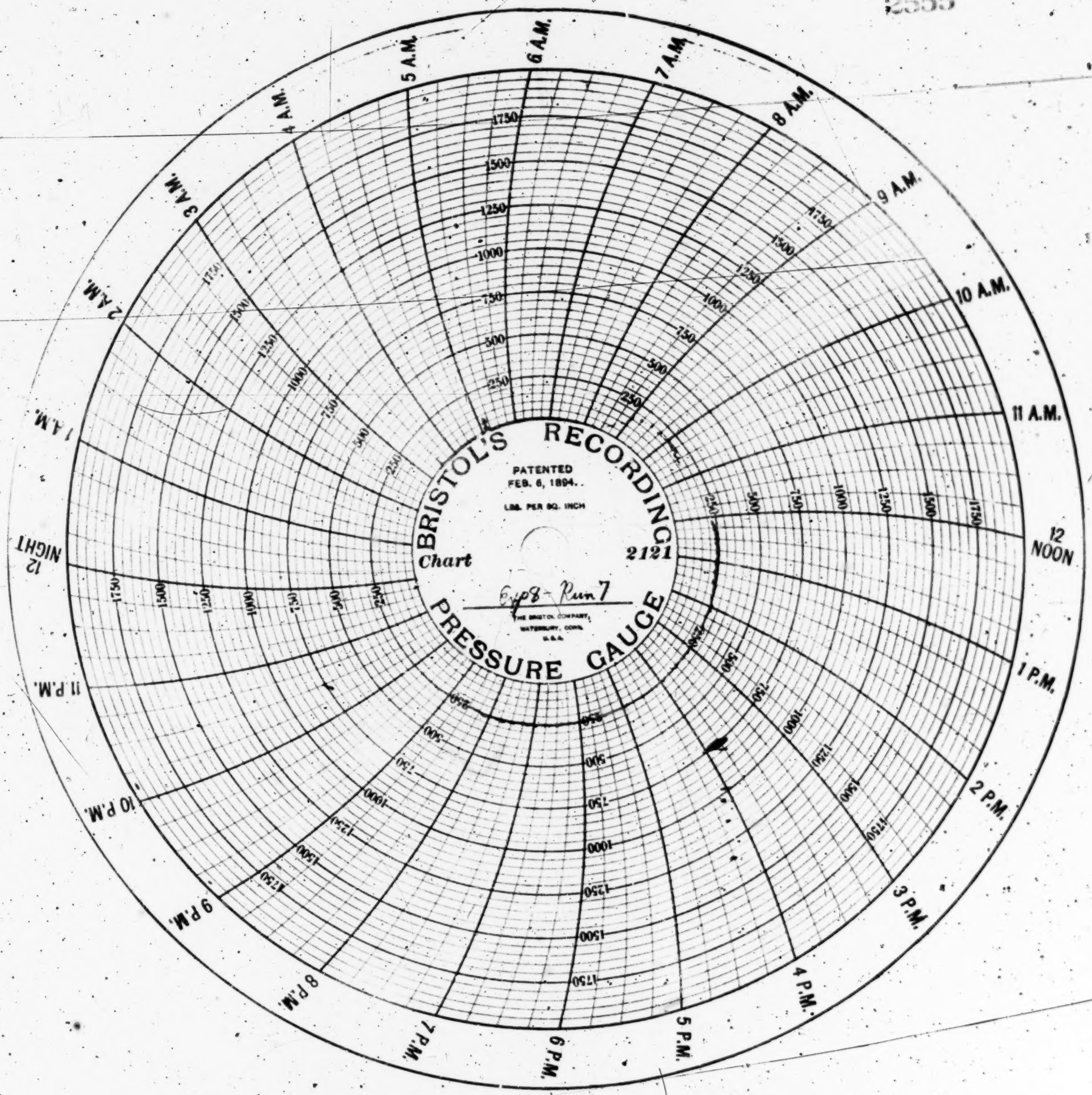
2551

Bakersfield & Fresno 7

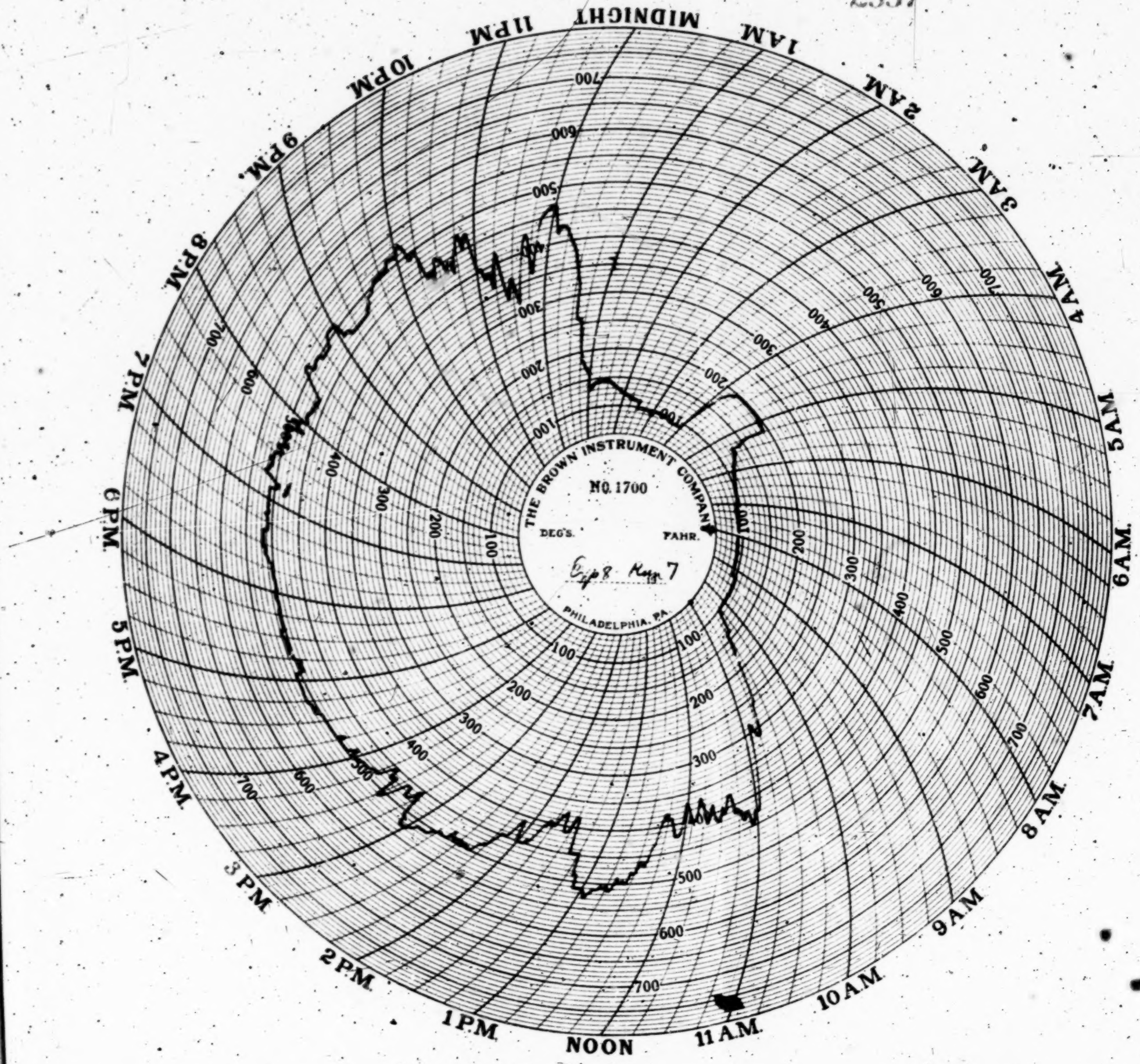
6/10/17

	Time	Oil	Deliveries				Run	
			Gallons	Gr	Gallons	Gr	Gallons	
6/10/17	5[th] AM	69930						
	6[th] AM	11 675						
	7[th] AM	19 425						70
	8[th] AM	33210						71
	10[th] AM	7770						72
	10[th] AM	15540						54
	11[th] AM	3885						55
	11[th] AM	11655						36
	12[th] NOON	7770						56
	2[th] PM	7770						42
	1[th] PM	46620						34
	1[th] PM	15540	36.0		15560	49		36
	2[th] PM	5827	5.4	34.8	5	51		62
	2[th] PM	1942	0.0		10	52		39
	3[th] PM	42735	0.0		20	46		1
	3[th] PM	15540	0.0		20	54		1
	4[th] PM	19425	5.0	37.5	5	49		32
	4[th] PM	19425	0.0		15	52		63
	5[th] PM	19425	5.0		10	48		44
	5[th] PM	15540	0.0		10	52		6
	6[th] PM	19425	0.0	32.4	8	48		52
	6[th] PM	15540	5.0		15	47		60
	7[th] PM	27195	5.0		20	48		71
	7[th] PM	31080	5.0		14	47		73
	8[th] PM	31080	0.0	33.5	21	48		71
	9[th] PM	15540	0.0		15	47		92
	9[th] PM	0000	15.0		10	47		13
	9[th] PM	30550	10.0		5	51		9
	9[th] PM					47		24
	Total	32,020	90.0					7
	Gain	551457	164.0		484	28		1

2555


BRISTOL'S RECORDING
PATENTED
FEB. 6, 1894.
LBS. PER SQ. INCH
Chart
2121
6 x 8 - Run 7
THE BRISTOL COMPANY,
WATERBURY, CONN.
U.S.A.
PRESSURE GAUGE
12 NIGHT
1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
6 A.M.
7 A.M.
8 A.M.
9 A.M.
10 A.M.
11 A.M.
12 NOON
1 P.M.
2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
9 P.M.
10 P.M.
11 P.M.
250
500
750
1000
1250
1500
1750

2557


MIDNIGHT
11PM
10PM
9PM
8PM
7PM
6PM
5PM
4PM
3PM
2PM
1PM
NOON
11A.M.
10A.M
9A.M
8A.M
7A.M.
6A.M.
5AM
4AM
3AM
2AM
1AM
100
200
300
400
500
600
700
THE BROWN INSTRUMENT COMPANY
NO. 1700
DEG'S.
FAHR.
PHILADELPHIA, PA.

8 Entered June 17 1917

Vessel 5 PM 6/14/17 to 11 PM 6/15/17

Experiment No A of 8
Date 6/14/17
Page
Steel P.B.90.
Record Runs

	Initial
Drinks 2210	11-7"
small supply	3-11 9/16"
fuel 4235	6'-6"
Distillate	0'-2"
Tar	0'-3/4"

800 mm 1016204
800 " 1049862
1000 " 1077776
1000 " 1047774
1000 " 1011988

Time	Throttles 1	2	Pressure Lbs Pump	Boiler Front	Rear	Drum	Fire Room	Temperature Degrees F. Coil 1	2	3	4	5	Drum	Vapor	Pyrometer Degrees F. 1	2	3	4	5	Feed Gauge Supply	Line	Distillate	Grease	Gravity Feed	Cooler	W BJ	Remarks
6/14/17 11.30 P.M.	25		230	15	25	20	0	220	250	420	510	450	170		840	1240	1820	1180	900	11-2 3/4	—	—	—	—	—		Steam on
12 Midnight	25		250	5	10	10	0	255	260	452	405	160			880	1210	1380	1310	750	11-1 7/8	—						Started at
6/15/17 12.30 A.M.	25		225	5	10	10	0	300	340	438	420	150			930	1320	1440	1335	800	11-1 3/8	0-1 1/2						5.30 P.M.
1.00 "	28		225	5	10	10	0	376	340	770	449	130			980	1380	1515	1510	860	11-1 1/2	0-1 3/4						Stopped with
1.30	18		225	3	10	10	0	418	450	670	440	495	110		1040	1430	1580	1600	920	11-2 1/8	0-2"						6/14/17
2.00	18		240	30	40	40	0	440	530	670	690	525	85		1100	1480	1630	1645	970	11-5/8	0-2 1/2						6/15/17 1.15 A.M.
2.30	16		230	98	105	105	0	506	570	685	738	540	45		1130	1510	1665	1700	1030	11-1/4	0-2 3/8		Leaky Gasket				Main pump
3.00	16		220	95	100	100	50	540	582	780	835	600	80		1180	1530	1670	1710	1040	11-0	0-2 1/2						discharged 5 3/4
3.30	14		160	150	155	160	50	570	625	730	775	618	45		1200	1550	1700	1740	1070	10-11 3/8	0-2 3/8		Gasket				5 min. = 22.68
4.00	14		200	175	182	182	50	550	625	805	895	649	155		1205	1545	1680	1760	1070	10-11 3/4	0-2 3/8		Gasket				fuel, water
4.30	12		250	225	230	230	50	570	630	840	865	676	200		1210	1585	1670	1615	1065	10-11 1/4	0-2 3/8		2 @ 3"	51.7	37.5		Started Engines
5.00	38		270	240	240	240	50	512	605	835	885	699	239		1230	1565	1670	1700	1075	10-10 3/8	0-3"	0-2		56.1	Rel.		
5.30	58		270	240	240	240	50	486	540	760	890	700	240		1210	1540	1670	1700	1060	10-10 1/2	0-3	0-2 1/2	4-0	56.1	Rel.		
6.00	63		300	250	258	259	50	478	620	710	850	708	990		1280	1525	1665	1700	1020	10-9"	0-3 1/8	0-2 1/2	2 @ 3"	54.5			
6.30	40		300	260	265	265	50	605	592	915	820	730	340		1200	1540	1670	1700	1040	10-8	0-3 1/8	0-2 1/2	4 @ 3"	52.2	Rel.	4@3	
7.00	41		340	260	270	275	50	499	530	780	815	745	400		1270	1580	1640	1680	1030	10-7 1/2	0-3 3/4	0-2 1/4	4 @ 3"	56.0			
7.30	42		350	260	260	260	55	512	533	760	810	780	415		1280	1525	1660	1700	1030	10-7	0-3 7/8	0-2 3/8	3 @ 3"	58.3	Rel.		
8.00	34		340	250	255	255	50	444	560	725	816	742	420		1295	1525	1660	1700	1025	10-6 1/2	0-4 1/4	0-2 3/4	2 @ 3"	50.0			
8.30																											

100"	28		25	5	10	10	0		376	31		770	447	130	780	1380	1515	1510	860	11-1¼	0-1½								
130	18		25	3	10	10	0		418	450	670	940	495	110	1040	1430	1580	1600	920	11-2⅜	0-2"								
200	18		40	30	40	40	0		440	530	670	690	525	85	1100	1480	1630	1645	970	11-5⅛	0-2½								
230	16		130	98	105	105	0		506	570	685	738	540	45	1130	1500	1665	1700	1030	11-¼	0-2⅞		2"	Gravel					
300	16		120	95	100	100	50		520	582	780	835	600	80	1180	1530	1670	1710	1040	11-0"	0-3"		2½"						
330			160	150	155	155	50		570	625	730	775	618	45	1200	1550	1790	1740	1070	10-11¾	0-2⅞		5½"	Gravel					
400	14		200	175	182	182	50		550	685	805	895	649	155	1205	1545	1680	1690	1070	10-11¾	0-2⅞		10½"	Gravel					
430	12		250	225	230	230	50		570	630	840	865	676	200	1210	1545	1670	1615	1065	10-11¼	0-2⅞		2-3"	51.7	373				
500	38		270	240	240	240	50		516	605	825	885	699	230	1220	1565	1670	1700	1075	10-10⅜	0-3"	0-2½							
530	58		270	240	250	250	50		486	544	760	890	704	240	1220	1540	1670	1700	1060	10-10½	0-3"	0-2½	4-0"	56.1	Rel				
600	53		300	250	258	258	50		478	620	710	850	708	390	1240	1530	1665	1700	1070	10-9"	0-3¼	0-2½	4-3"	54.3					
630	40		300	260	265	265	50		605	532	715	820	730	340	1200	1540	1670	1700	1040	10-8	0-3½	0-2½	4-0	55.2	Rel	40.3			
700	41		340	250	250	255	50		599	530	720	815	725	400	1205	1530	1640	1680	1030	10-7½	0-3⅝	0-2½	5-2½	56.0					
750	40		350	260	260	260	55		512	533	760	810	730	410	1200	1525	1660	1700	1030	10-7	0-3⅝	0-2⅝	3-8½	58.3	Rel				
800	34		340	250	255	255	50		444	560	725	816	742	420	1195	1526	1660	1700	1025	10-6½	0-4¼	0-2¾	0-11½	55.0					
830	32		320	260	260	260	50		534	575	735	830	745	410	1200	1560	1695	1700	1040	10-5⅞	0-4¾	0-3	2-2½	55.8	35.0	37.1			
900	35		325	260	260	265	50		564	586	730	820	730	440	1195	1540	1670	1710	1030	10-5½	0-5"	0-3⅛	4-11	52.9	Rel				
930	34		350	270	270	275	50		540	595	730	835	740	400	1195	1540	1680	1700	1030	10-4¾	0-5⅛	0-3¼	4-4"	51.3					
1000	34		340	260	260	270	50		570	695	745	840	740	440	1200	1545	1680	1700	1030	10-4¾	0-5½	0-3¼	5-8"	49.9	Rel				
1030	33		320	270	275	275	50		580	600	755	840	750	440	1200	1550	1680	1700	1035	10-3¾	0-5½	0-4½	1-6½	503	35.0	37.5			
1100	33		345	265	270	270	50		586	610	750	845	758	460	1210	1560	1675	1720	1040	10-3⅜	0-5⅞	0-4⅝	4-6	48.7	Rel				
1130	34		350	260	270	270	50		588	615	760	850	762	450	1210	1570	1700	1750	1050	10-2¾	0-5⅞	0-5	3-5½	49.8					
1200	43		400	280	280	285	50		578	615	765	855	768	470	1210	1560	1690	1725	1050	10-2	0-5¾	0-5⅝	5-2	46.6	Rel				
1230	45		525	285	285	290	50		510	570	730	835	768	460	1195	1530	1660	1700	1040	10-7⅛	0-5¾	0-6⅛	5-4"	46.9	Rel	36.4			
1300	45		410	285	285	290	50		530	576	746	840	764	440	1205	1550	1720	1750	1045	10-¼	0-5¾	0-6½	2-5	47.6					
1330	40		410	280	280	285	50		545	580	735	835	762	420	1200	1560	1695	1725	1050	9-11⅛	0-5¾	0-6¼	5-4"	48.1	Rel				
1400	33		400	270	270	280	50		540	580	735	850	762	430	1200	1560	1700	1730	1045	9-10⅜	0-6⅛	0-7¼	2-11½	51.2					
1430	32		380	280	280	285	50		578	600	755	850	762	430	1205	1560	1700	1730	1040	9-10⅛	0-7⅛	0-7⅝	5-6	50.9	Rel	36.1			
1500	32		380	270	275	285	50		594	615	760	855	762	450	1210	1565	1705	1730	1045	9-9¾	0-6½	0-7⅞	3-5"	49.5	Rel				
1530	37		370	295	295	300	50		600	625	765	865	766	450	1210	1570	1710	1740	1050	9-9¼	0-6¾	0-8⅛	3-3½	48.0	Rel				
1600	65		500	270	270	275	60		580	615	760	860	768	465	1210	1570	1710	1730	1050	9-8¾	0-6¾	0-8⅛	3-1½	46.4	Rel				
1630	65		540	265	265	270	55		530	570	735	835	768	440	1220	1570	1720	1745	1045	9-7⅛	0-6¼	0-	3-2½	46.3	Rel	36.0			

Experiment No Cal 8
Date 6/15/17
Page 2

Record of Runs

Final Gauges.

Cal 8

	Pawl
Jaw 11 3/8.	0-11 5/8
Dist 1'-1 1/2	1-1 1/2
V 10. - 8'-10 5/8"	8-10 5/8
4 V 3 - 6'-4 5/8"	6-4 5/8
Small Supply 3'-10 1/4"	3-10 1/8

Differences between Pawl & Cam surfaces

2561

June	Run No. 1	Run No. 2	Pressure Lbs Ring	Pressure Lbs Cal Inlet	Pressure Lbs Cal Exit	Pressure Lbs Drum	Pressure Lbs Receiver Drum	Temperature Degrees Fahrenheit Cal 1	Cal 2	Cal 3	Cal 4	Cal 5	Temperature Degrees Fahrenheit Drum	Temperature Degrees Fahrenheit Vapor	Pyrometer Degrees F 1	2	3	4	5	Tank Gauge Duffy	Tank Gauge Low	Tank Gauge Destrie	Formula	Quantity Dist	Quantity Fuel	Quantity BJ	Remarks
PM 5:00	64		580	265	265	270	50		512	565	730	835	754	440	1210	1570	1700	1730	1040	9-6 3/8	0-6 1/2	0-9 1/2	2-8	463			
5:30	46		450	265	265	270	60		508	545	730	835	738	440	1210	1670	1710	1735	1030	9-5 1/8	0-7 1/4	0-9 1/2	4-7	493	Rel		
6:00	37		990	265	275	270	60		549	576	750	865	730	330	1215	1580	1720	1745	1040	9-4 7/8	0-7 1/2	0-10	1-7 1/2	504			
6:30	38		400	280	280	285	60		5[illegible]	600	755	865	715	420	1225	1545	1725	1745	1045	9-4 1/2	0-8 1/8	0-9 3/4	4-8	539	Rel		
7:00	30		350	275	275	275	50		585	620	770	865	695	450	1215	1560	1700	1750	1060	9-3 1/2	0-8	0-10 3/8	2-5	500			
7:30	34		360	295	290	290	50		600	625	785	870	678	450	1220	1555	1680	1710	1060	9-3 1/2	0-8	0-10 3/8	6-6	496	Rel		
8:00	35		350	265	265	265	50		594	625	780	875	660	450	1220	1560	1680	1710	1060	9-2 3/8	0-8 1/8	0-11 1/4	3-0	498	Rel		
8:30	36		350	290	290	290	50		588	625	780	870	650	440	1220	1560	1670	1700	1060	9-2	0-8 1/8	0-11 1/2	2-5	494	36.2	36.2	
9:00	32		350	290	290	290	50		594	625	790	875	653	430	1220	1560	1665	1700	1060	9-1 3/8	0-8 1/8	0-11 3/8	5-2	491	Rel		
9:30	32		340	280	280	280	50		590	625	790	875	650	440	1220	1560	1660	1700	1060	9-1/8	0-8 1/8	1-3/16	8-1	543			
10:00	33		340	270	270	270	50		582	620	780	875	640	440	1220	1535	1660	1700	1060	9-3/4	0-8 1/4	1-3/16	5-2	499	Rel		
10:30	31		340	265	265	265	50		585	620	775	870	630	430	1220	1530	1650	1690	1050	8-11 3/8	0-7	1-3/16	4-2	494	35.7	35.7	Rel
11:00	30		340	275	275	275	50		582	625	778	870	620	430	1220	1520	1640	1680	1050	8-11 1/4	0-8	1-1	2-6	490			
																				8-10 7/8	0-11 5/8	1-1 3/16	6-11 1/2	Rel			

Coil 6/1/17

	11:30 Am	11:30	11:30	6:30	6:30	6:30	8:30	8:30	8:30	10:30	10:30	10:30
	Acc.	Car	Bro.	Acc.	Car	Bro. J.	Acc.	Car	Back	Acc.	Car	Back
Mile	51.7	37.8	43.1	53.2	36.2	40.8	52.8	35.6	37.5	58.3	55.0	37.5
1/4	130	444	176	83	406	292	104	306	270	116	262	318
5'	184	462	252	118	452	332	126	384	402	164	370	370
10'	210	474	292	158	468	352	164	430	424	204	414	406
15'	232	484	342	192	484	374	194	460	440	240	454	422
20	248	494	372	218	494	394	222	476	448	270	472	440
25'	264	502	388	244	500	414	242	488	458	296	484	454
30	278	506	408	264	506	429	260	496	467	318	494	462
35'	292	510	422	286	512	439	282	504	472	340	502	472
40	306	516	432	308	514	448	300	511	480	362	510	482
45'	320	524	442	330	524	456	320	576	486	384	517	488
50	334	531	452	354	530	464	332	523	492	402	524	494
55'	350	537	460	378	538	472	360	533	496	418	532	502
60'	364	542	472	400	546	480	380	544	504	436	542	508
65'	382	548	480	416	554	488	394	552	510	446	553	516
70'	396	556	488	436	562	496	412	562	520	460	562	526
75'	412	566	496	452	572	504	432	572	528	470	572	534
80'	428	578	504	468	584	512	452	590	536	484	592	546
85'	446	590	520	496	600	526	474	612	546	504	616	556
90'	464	608	542	512	616	542	500	636	564	532	644	578
95'	482	638	563	—	640	564	—	710	584	—	—	604
Stop	496	688	582	542	696	582	542	750	610	556	—	638
Take	96	99	78	92	99	74	94	79	78	95	—	—

2563

Still 8 6/10/11

	12:30 Bar	12:30	12:30	2:30	2:30	2:30	4:30	4:30	4:30	6:00	6:00	6:00
	Dist	Tar	Bark Tar	Dist	Tar	Leather	Dist	Tar	Leather	Dist	Tar	Bark Tar
DW	46.9	32.2	36.4	50.9	32.6	36.4	46.3	32.3	36.0	52.9	31.4	36.3
01	114	240	366	108	246	250	184	250	214	100	195	81.2
5	164	368	402	166	370	344	210	362	318	142	294	362
10	208	430	428	210	424	400	234	424	386	178	432	406
15	246	444	440	234	460	432	248	452	416	203	458	422
20	280	474	456	268	472	440	264	468	440	230	474	440
21	312	485	480	290	484	450	278	480	458	254	488	450
30	336	494	464	311	492	460	294	488	468	278	498	466
31	365	505	470	330	498	474	296	500	476	304	508	470
40	390	516	478	356	508	480	320	510	484	324	522	478
41	410	523	486	380	516	487	336	518	494	346	534	492
50	424	533	490	400	524	496	350	524	502	369	542	494
55	436	542	502	416	532	502	364	532	508	389	550	500
60	452	551	508	430	542	508	382	540	514	407	560	508
65	462	564	516	446	552	518	396	554	522	424	570	517
70	474	574	522	462	564	522	412	568	528	442	576	523
75	488	590	530	472	574	534	428	580	540	458	592	531
80	506	610	542	488	592	544	446	596	552	473	606	540
85	514	632	554	503	620	560	465	614	566	494	632	558
90	538	662	576	542	662	572	482	636	584	526	696	586
95	550		600	—		—	496		610	—	—	—
8	576		630	—		—			668	—	—	—
Tube	96		—	—	90	—	96	90	98	—	90	—

2565

6/15/17 Prac Qual 6/15/17

	8:30 Prac	8:30 Qual	10:30	10:30 Prac	10:30 Qual
	Lux	Star	Hunt	Sun	Bank
	494	309	362	492	314	257
4	111	334	342	108	224	316
5	158	426	388	152	376	370
10	204	452	414	184	432	400
15	236	474	432	226	468	426
20	268	490	450	256	478	442
25	294	502	460	284	496	458
30	314	510	468	306	506	470
35	334	516	476	332	512	480
40	362	522	488	368	520	488
45	384	530	496	378	526	494
50	406	538	502	402	534	500
55	420	548	508	422	542	506
60	440	560	514	436	550	512
65	452	570	524	446	560	518
70	458	582	532	462	570	524
75	476	596	546	478	586	532
80	490	620	556	486	600	542
85	504	646	564	500	632	630
90	536	690	580	530	684	574
95	648		616	536		612
100	670		664	572		666
% Rec	96	90	98	96	90	98

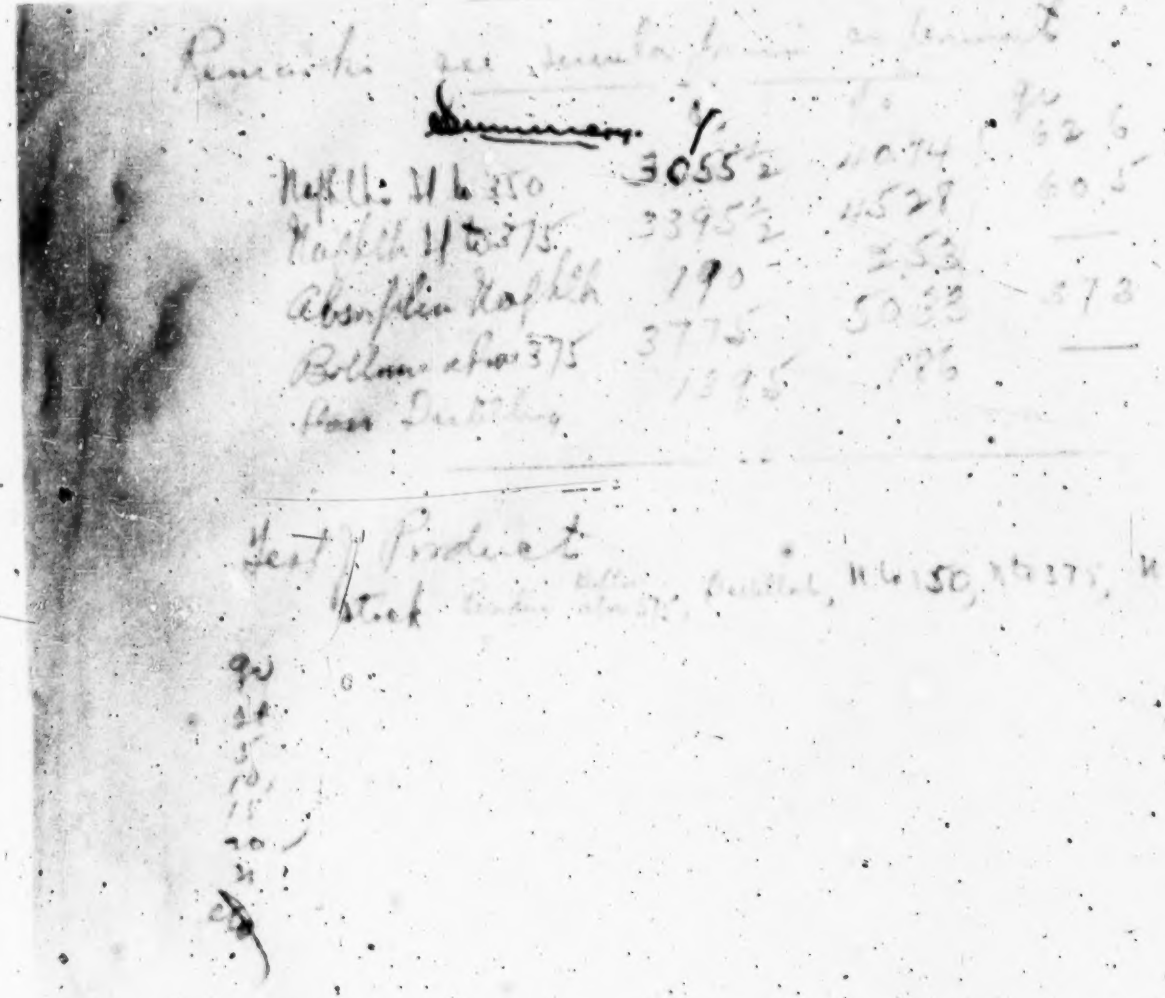
2567

		Heat Input	Flow		Delta			Inc.
6/5/17	12 PM	19425	0.00	—	1050	47.6	—	47.5
	1:30 PM	27195	0.00	—	1050	44.1	—	57.3
	2:00 PM	23310	1575	—	2100	51.2	—	58.1
	2:30 PM	11655	0.00	32.6	1050	50.9	34.7	49.1
	3:00 PM	15540	1575	—	1575	47.5	—	67.1
	3:30 PM	15540	0.00	—	1575	48.0	—	72.8
	4:00 PM	23310	0.00	—	2625	46.4	—	61.4
	4:30 PM	38850	0.00	32.3	1575	46.2	36.20	63.0
	5:00 PM	27195	0.00	—	1050	46.3	—	52.5
	5:30 PM	34965	3150	—	0.00	49.3	—	37.6
	6:00	19425	1050	—	2100	50.4	—	35.2
	6:30	15540	3150	31.6	0.00	52.9	36.0	56.5
	7:00	19425	0.00	—	2625	50.0	—	47.5
	7:30	7770	0.00	—	525	49.6	—	60.6
	8:00	27195	0.00	—	2100	49.8	—	58.7
	8:30	11655	0.00	30.9	1050	49.4	36.2	47.5
	9:00	19425	0.00	—	1575	49.1	—	54.0
	9:30	15540	0.00	—	1575	51.3	—	60.6
	10:00	15540	0.00	—	525	49.9	—	40.9
	10:30	19425	0.00	31.4	1575	49.2	35.7	51.8
	11:00	15540	0.00	—	1575	49.0	—	49.1
	Sunday	20713	1417.5	—	3150	—	—	136.7
	Total	100970	4567.5		46200			2558.2

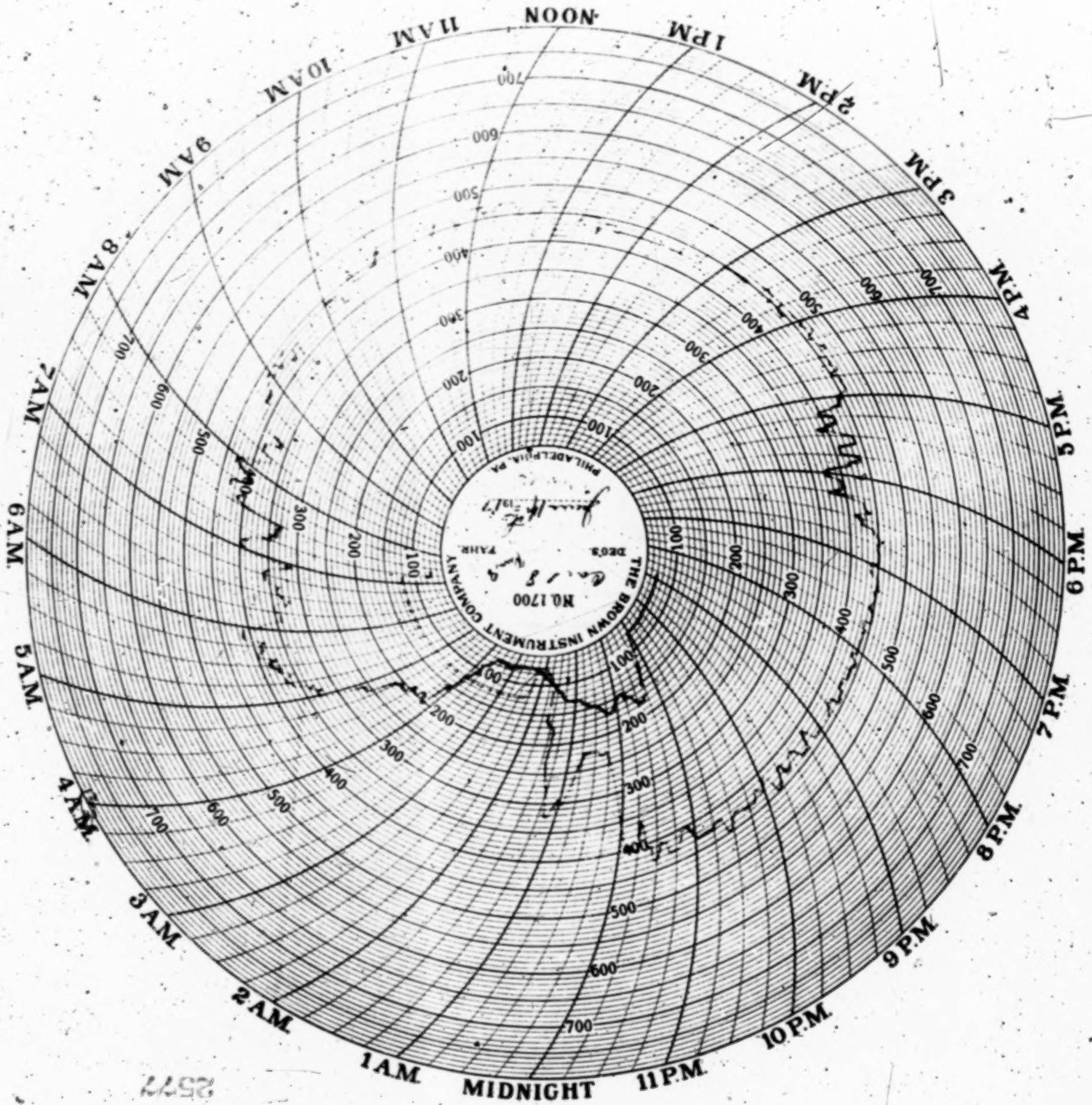
Col 5 Recall from Sheet 2 Row 8

Date	Time	Gallons	Reading Gallons	Reading Flow Rate	Duplicate Gallons	Duplicate Flow Rate	Rain mm/hr	Gas m³/h
4/5/17	11:30 PM	142,750						
	12:00	15,540						
	12:30 am	7,770	31.00					
	1:00 am	11,655	10.50					
	1:30 am	11,655	21.00					
	2:00 am	7,770	10.50					73.5
	2:30 am	11,655	5.25					47.6
	3:00 am	7,770	5.25					6.6
	3:30 am	5,825	5.25					17.8
	4:00 am	13,575	5.25					44.2
	4:30	5,820	0.00	57.3		51.7	4.21	44.2
	5:00	11,655	10.50		—	60.1	—	16.1
	5:30 am	11,655	0.00	—	5.25 ✓	56.1		4.6
	6:00	46,620	5.25	—	5.25 ✓	54.2	—	44.2
	6:30	19,425	21.00	30.2	5.25 ✓	53.2	2.3	37.6
	7:00	19,425	5.25	—	5.25 ✓	56.0		2.2
	7:30	23,310	5.25	—	5.25 ✓	51.3		47.1
	8:00	15,540	15.75	—	5.25 ✓	56.0	—	18.7
	8:30	19,425	21.00	35.6	10.50 ✓	55.8	3.5	34.6
	9:00	19,425	10.50	—	5.25 ✓	53.1	—	53.2
	9:30	15,540	15.75		15.75 ✓	51.3	—	26.2
	10:00	19,425	5.25	—	10.50 ✓	49.9	—	47.5
	10:30	11,655	0.00	35.0	21.50 ✓	50.3	3.5	30.3
	11:00	19,425	5.25	—	5.25 ✓	46.7	—	5.1
	11:30	15,540	0.00	—	15.75 ✓	51.1	—	48.3
	12:00	19,425	5.25	—	26.25	46.6	—	53.2
	12:30		0.00	32.2	26.25	46.1	3.5	15.2

2523



2575


NOON
1PM
2PM
3PM
4PM
5PM
6PM
7PM
8PM
9PM
10PM
11PM
MIDNIGHT
1AM
2AM
3AM
4AM
5AM
6AM
7AM
8AM
9AM
10AM
11AM
100
200
300
400
500
600
700
THE BROWN INSTRUMENT COMPANY
PHILADELPHIA, PA.
No. 1700

89

Entered
Aug 2/1917

Run 5th am 6/26/17 to 12:00 noon 6/29/17

Experiment No 8. Run 9
Stock Paraffine Base Gas Oil
Date 1917
Page 1
Record of Runs

Tank Measurement

2210 Supply tank	16'-1/4"
Small Supply tank	2'-10 1/2"
Distillate	0'-0"
Tar	0'-3 1/4"
4235 Day tank	6'-3 1/2"

Start Gas Mete. 20790 — Close Gas Mete

Time	Pump Strokes 1	2	Pressure Lbs. Pump	Coil Inlet	Coil Outlet	Worm	Receiver	Temperature Degrees F. Coils 2	3	4	5	Worm	Vapor	Pyrometers Degrees F. 2	3	4	5	Tank gauges Supply 2210	Tar	Dist.	Gas Tank meter	Gravity Dist	Tar	Back trap	REMARKS.
6/26/17	5:15 pm	(Begin steady flow)					(Stop)	(End)	(flow)	(again)			(Stop)	(Again)											10:00 A.M. Pumping 4 1/2 per min. or 6.156 gal per hour
Apm	10:00	60	-	75	0	15	0	0	460	515	510	530	460	440	960	1070	1060	890	700	11'-4 1/8"	-	-					
	10:30	56	+	78	0	15	0	0	450	495	454	535	435	400	820	1070	995	870	695	11'-10"	-	-					
	11:00	60	-	75	0	15	0	0	450	300	460	635	415	[illegible]	801	[illegible]	[illegible]	895	700	11'-9"	-	-					
	11:30	42	-	85	10	[illegible]	0	0	445	375	465	650	450	150	801	1110	11[illegible]	1020	7[illegible]	11'-8 3/4	-	-					
	12:00	36	-	75	0	10	0	0	375	340	540	640	340	140	550	1160	1170	1130	770	11'-7 7/8	-	-					
	12:30	31	-	75	0	15	0	0	335	400	560	675	415	735	870	1185	1210	1165	810	11'-7 1/4	0-1 3/8"	-					
	1:00	28	-	75	10	15	0	0	310	475	590	715	490	1140	985	1210	1230	1200	840	11'-6 3/4	0-1 5/8"	-					1:15 P.M. Pumping 4" per min.
	1:30	23	-	[illegible]	0	15	0	[illegible]	[illegible]	[illegible]	605	725	505	160	920	1215	1240	1215	860	11'-6 3/4	0-2 1/4	-					
	2:00	20	-	75	10	25	[illegible]	0	420	445	630	760	520	150	440	1230	1240	1230	890	11'-6 1/4	0-2 1/4	-					2.59 P.M. gas per hr.
	2:30	34	-	65	10	30	15	0	420	475	635	790	595	160	960	1250	1290	1295	900	11'-5 1/2"	0-3"	-					
	3:00	35	-	50	10	25	25	0	440	475	645	805	550	160	1[illegible]	[illegible]	1310	1325	910	11'-6 1/4	0-3"	-					
	3:30	35	-	50	15	25	20	0	415	470	650	810	570	160	1000	1270	1330	1350	920	11'-4 5/8	0-3 1/4	-					3:45 P.M. Pumping 3 1/2" per 5 min.
	4:00	35	-	50	10	50	10	0	420	485	665	815	590	170	1000	1290	1350	1370	930	11'-4 3/8	0-4 1/8	-					
	4:30	28	-	105	50	60	50	0	510	520	685	815	[illegible]	170	1020	1320	1360	1380	940	11'-4 1/4	0-4 1/2	-					3.56 gal per hr.
	5:00	28	-	60	65	65	60	0	475	530	715	800	610	170	1040	1310	1375	1395	950	11'-4 1/4	0-4 1/2	-					
	5:30	31	-	90	80	90	80	0	545	560	750	740	610	170	1060	1320	1390	1415	980	11'-3 7/8	0-4 5/8	-					
	6:00	32	-	160	[illegible]	[illegible]	0	0	575	595	695	750	595	160	1070	1340	1405	1430	1000	11'-3 3/8	0-4 3/4	-					6 P.M. Ran

Apr																										
	10:30	54	+	78	0	15	0	0	455	495	645	635	435	200	830	1070	995	870	695	11-10"	-	-				min. of 1.56 gal
	11:00	60	-	75	0	15	0	0	450	300	460	635	415	[illegible]	801	[illegible]	[illegible]	895	700	11-9"	-	-				per hour
	1:30	42	-	85	10	[illegible]	0	0	445	375	[illegible]	650	450	150	801	1110	11[illegible]	1070	7[illegible]	11-8¾	-	-				
P.M.	[illegible]	36	-	75	0	15	0	0	425	360	540	[illegible]	[illegible]	140	850	1160	1170	1130	770	11-7⅞	-	-				
	4:30	31	-	75	0	15	0	0	335	[illegible]	560	675	445	135	870	1185	1210	1165	810	11-7¼	0-1⅜	-				
	1:00	28	-	75	0	15	0	0	380	425	590	715	490	140	905	1210	1230	1200	840	11-6¾	0-1⅜"	-				#15 Pr. Pump
	1:30	29	-	[illegible]	0	15	0	0	[illegible]	[illegible]	605	725	500	160	920	1215	1240	1215	860	11-6⅝	0-2"	-				2" pump 6 min.
	2:00	30	-	75	0	25	0	0	420	465	630	760	520	150	940	1230	1240	1220	890	11-6⅛	0-2 1/4	-				2.5 gal per
	3:30	34	-	75	15	30	15	0	435	475	635	795	595	180	[illegible]	[illegible]	1250	1290	1395	900	11-5	0-3"	-				
	8:00	35	-	50	0	25	25	0	[illegible]	475	645	805	650	[illegible]	[illegible]	[illegible]	1310	1325	910	11-5	0-3"	-				
	9:30	35	-	50	15	40	20	0	415	478	650	810	595	160	1000	1220	1330	1350	920	11-4⅝	0-3¼	-				3.45 Pr. Pump
	11:00	35	-	50	40	50	40	0	420	485	665	815	590	170	[illegible]	1290	1350	1370	930	11-4⅜	0-4⅜	-				2¾ gal 5 min.
	4:30	[illegible]	-	65	60	60	50	0	410	500	685	815	[illegible]	170	1030	1320	1360	1380	940	11-4¼	0-4¼	-				3.56 gal
	6:00	[illegible]		60	60	65	[illegible]	0	475	530	715	800	610	190	1040	1310	1375	1395	950	11-4¼	0-4½	-				
	[illegible]	31		90	80	90	80	10	545	660	950	740	610	170	[illegible]	1320	1390	1415	980	11-3⅜	0-4⅜	-				
	6:00	33		160	[illegible]	[illegible]	[illegible]	0	675	595	695	950	595	160	1070	1340	1405	1380	1000	11-3⅜	0-4⅜	-				6 Pr. Pump
	6:30	[illegible]		225	[illegible]	[illegible]	200	[illegible]	620	610	805	[illegible]	[illegible]	160	[illegible]	1350	1410	[illegible]	1010	11-2"	0-4¾	-	1-5"			2½" pump 6
	7:00	15		270	240	[illegible]	235	[illegible]	[illegible]	610	[illegible]	[illegible]	780	[illegible]	[illegible]	1350	1420	[illegible]	1010	11-1¾	0-5½	-	3'-9"			32.6 gal per
	7:30	18		285	[illegible]	[illegible]	215	[illegible]	[illegible]	620	770	[illegible]	604	[illegible]	1100	1350	[illegible]	[illegible]	1010	11-[illegible]	0-5⅝	-	2-8"			Gas cannot
	8:00	[illegible]		[illegible]	255	250	[illegible]	50	[illegible]	630	795	746	[illegible]	[illegible]	1110	[illegible]	[illegible]	1460	1030	11-1¼	0-5⅝	-	5-5½			Rec
	8:30	19		240	230	230	[illegible]	50	[illegible]	615	790	820	[illegible]	340	1095	1360	[illegible]	1490	1090	11-1"	[illegible]	-	4'-4½	76.2		Rel.
	9:00	19		245	240	235	230	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	634	300	1070	1350	1440	1480	1010	11-¾"	0-[illegible]	-	3'-0"	73.8		
	9:30	19		250	250	[illegible]	240	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1060	1380	1520	1580	1010	11-½"	0-5⅝	-	5-8"	71.9		Rel.
	11:00	16		250	250	250	245	50	554	600	740	820	[illegible]	350	1070	1380	1530	1595	1005	11-¼"	0-5⅞	0-¾	3'-10"	69.3		Rel
	10:30	16		250	245	[illegible]	[illegible]	50	540	595	755	850	[illegible]	350	1040	1380	1530	1600	1000	11-0"	[illegible]	0-3¼	2'-5"	66.3		
	11:00	22		245	230	230	225	50	534	686	765	830	614	370	1050	1380	1535	1600	1000	10-11⅜	0-6¼	0-½	4'-5"	64.0	40.0	39.0	Rel
	11:30	22		230	220	220	215	50	524	[illegible]	[illegible]	825	704	[illegible]	1030	1390	1540	1615	995	10-11⅛	0-6¼	0-5⅝	2'-6"	62.6			Rel
6-27-11	12:00	21		225	210	210	205	50	520	665	735	870	694	410	1080	1390	1560	1635	995	10-10¾	0-6⅞	0-⅝	1'-7"	60.6			
A.M.	12:30	24		210	205	205	200	50	512	650	725	855	670	460	1030	1380	1530	1610	990	10-10⅜	0-6⅝	0-¾	3'-8"	56.6			Rel
	1:00	19		225	220	215	210	50	524	665	730	846	690	340	1020	1370	1530	1605	980	10-9⅞	0-6⅝	0-¾	10-10	55.9	37.5	39.6	
	1:30	20		240	205	205	200	50	526	565	730	846	694	424	1020	1385	1545	1620	980	10-9⅞	0-7¼	0-⅞	2'-4"	60.7			
	2:00	20		215	220	210	215	50	550	575	740	848	686	370	1025	1400	1570	1620	995	10-9⅜	(0-6¼)	0-¾	3'-5"	60.4			Rel
	2:30	20		200	195	195	190	50	548	580	740	860	648	495	1030	1400	1575	1620	995	10-9	0-7½	0-⅞	1'-6½	55.9			
	3:00	20		215	205	210	200	50	564	590	725	865	694	410	1080	1410	1580	1620	1000	10-8¾	0-7½	0-1"	2'-4½	57.9	36.4	39.1	
	3:30	18		215	205	205	200	50	558	585	735	870	662	400	1015	1430	1580	1670	1000	10-8½	0-7½	0-1"	3'-7½	58.4			Rel
	4:00	18		215	210	210	206	50	556	580	745	875	640	470	1050	1435	1600	1700	1010	10-8¼	0-7½	0-1⅛	1'-11½	58.2			
	4:30	18		215	210	205	200	50	572	590	740	860	682	500	1050	1415	1580	1665	1005	10-7⅞	0-7½	0-1¼	3'-5"	53.7			
	5:00	[illegible]		210	200	205	195	50	576	595	730	865	664	495	1040	1415	1580	1670	1000	10-7½	0-7¾	0-1½	1'-2"	55.4	34.9	38.2	
	5:30	19		210	200	205	190	50	566	585	730	860	690	48[illegible]	1040	[illegible]	[illegible]	[illegible]	1000	10-7½	0-7¾	0-1¾	2-10	55.0			
	6:00	20		210	200	200	195	50	562	575	735	875	682	400	1040	1420	1600	1690	1000	10-7⅛	0-7¾	0-1¾	3'-5½	55.4			Rel
	5:30	23		220	195	200	195	50	670	590	735	870	702	420	1040	1440	1610	1700	1000	10-6¾	2-5"	0-1¾	4'-4"	55.6			

min. of 1.56 gal per hour

#15 Pr. Pump

2" pump 6 min. of 2.5 gal per

3.45 Pr. Pump

2¾ gal 5 min. 3.56 gal

6 Pr. Pump

2½" pump 6

32.6 gal per

Gas cannot

Rec

Rel.

Rel.

Rel

Rel

Rel

Rel

Rel

Rel

Rel

Rel

Rel

Rel

Experiment No 8, Run 9
Stock Pennsylvania Bunker Coal
Date 6/27/17
Page 4
Record of Runs

Initial Measurements
Supply Tank 2210 —
Small Supply Tank —
Distillate Tank —
Test Tank —
Fuel Tank 4255

Time	Fuel Valve 1	Fuel Valve 2	Pressure Lbs Oil	Pressure Lbs Oil Fuel	Pressure Lbs Oil Distillate	Pressure Lbs Air	Pressure Lbs Exhaust	Temperature Degrees F Locks 2	Locks 3	Locks 4	Locks 5	Brass	Valve	Propeller Degrees F 1	2	3	4	5	Tank Gauges Supply 7210	Test	Distillate	Gasometer	Gravities Dark	Gravities Test	Gravities B.T.	Remarks
7:00	26		220	220	220	210	50	605	615	750	845	698	490	1100	1445	1600	1700	1030	10'-6½"	0'-8¼"	0'-1⅝"	3'-2"	568	351	385	
7:30	40		230	230	225	215	50	630	690	760	885	667	440	1100	1440	1590	1690	1030	10'-6"	0'-8¼"	0'-2"	3'-2	580	Rel			
8:00	26		250	240	240	230	50	635	660	740	870	665	470	1100	1435	1568	1687	1015	10'-5½"	0'-8¼"	0'-2⅛"	3'-8½"	565				
8:30	26		260	240	240	230	50	630	650	705	860	630	470	1100	1430	1590	1675	1015	10'-4⅝"	0'-8⅜"	0'-2⅜"		554		39		
9:00	37		260	240	235		50	634	660	720	860	634	445	1085	1426	1580	1705	1018	10'-4⅛"	0'-8⅜"	0'-2½"	Rel	551	335	297	Released.
9:30	30		260	240	230		50	630	660	718	864	640	485	1090	1410	1560	1670	1010	10'-3¼"	0'-9"	0'-2½"	3'-8"	564			
10:00	30	28	260	240	230		50	640	660	710	850	646	470	1080	1400	1550	1650	1005	10'-3⅛"	6'-9⅞"	0'-2⅝"	3'-7"	577			
10:30	29		260	240	230		50	640	670	720	855	695	450	1080	1420	1580	1690	1010	10'-2⅞"	0'-10"	0'-2¾"	3'-7"	594			Rel.
11:00	29		260	240	230	210	50	640	665	710	860	670	460	1085	1430	1585	1690	1005	10'-2⅞"	0'-10'	0'-2 ¾"	4'-9"	60.1			
11:30	29		260	240	230	210	50	646	675	690	835	686	500	1080	1420	1580	1670	1000	10'-2½"	0'-10½"	0'-2⅜"	2'-5"	579			
12:00	29		260	240	230	208	50	645	660	710	840	700	500	1080	1420	1565	1670	1005	10'-1⅞"	0'-10⅞"	0'-2 7/8	3'-5"	54.3			
12:30	29		270	245	240	230	50	660	680	715	855	685	495	1080	1420	1590	1685	1005	10'-1⅜"	0'-11"	0'-3"	4'-7"	577			Rel.
1:00	26		250	235	235	225	50	647	685	720	850	728	500	1080	1430	1600	1705	1005	10'-1⅛"	0'-11"	0'-3⅛"	1'-4"	5'-3	353	387	
1:30	26		250	235	235	225	50	647	685	720	840	736	470	1080	1430	1605	1710	1005	10'-5⅛"	0'-11⅛"	0'-3½"	2'-5½"	543			
2:00	25		250	235	235	225	50	640	680	710	850	740	500	1080	1420	1585	1680	1000	10'-4"	0'-11"	0'-3⅜"	3'-7"	54.3			Rel.
2:30	25		240	230	230	220	50	670	670	720	855	736	460	1085	1425	1590	1690	1005	Rain	—	—		59.4			Rain
3:00	24		250	238	240	230	50	670	680	720	860	733	460	1080	1430	1590	1690	1010	9'-11½"	0'-11½"	0'-3½"	1'-9"	5'-9	3'-3		
3:30	23		240	235	240	230	50	670	685	720	860	740	500	1080	1430	1600	1700	1010	9'-11"	0'-11¾"	0'-3⅝"	2'-4"	55.1			
4:00	22		250	245	235	225	50	540	575	710	835	730	485	1080	1420	1590	1690	1000	9'-10½"	0'-11⅞"	0'-3⅞"	5'-3	56.7			Released
4:30	25		240	230	230	220	50	575	580	715	855	726	520	1080	1425	1580	1680	1005	9'-10⅛"	1'-0"	0'-4"	6'-9"	53.5			
5:00	24		250	245	238	230	50	582	590	725	865	740	480	1085	1430	1600	1710	1010	9'-9⅝"	1'-1/16"	0'-4¼"	2'-2"	54.3	347	38.2	
5:30	24		265	245	240	235	50	570	590	725	850	747	530	1080	1420	1600	1705	1010	9'-9⅛"	1" 3/16"	0'-4¼"	4'-0"	54.9			Rel.
6:00	36		260	235	240	230	50	662	575	720	845	740	610	1080	1418	1595	1700	1005	9'-8⅞"	1' ½"	0'-4⅛"	1'-2"	52.0			Rel.

9:00	31		250	225	225		50	534	560	720	860	624	445	1085	1446	1580	1705	1618	10-4½	0-0½	0-2¾		65.4					Released
9:30	30		240	220	225			520	540	718	864	640	485	1090	1410	1620	1620	1010	10-3¾	0-9"	0-2½		64					
10:00	29	76	230	215	215		50	640	5100	710	850	646	470	1090	1400	1550	1650	1005	10-3¼	6-9⅞	0'-2¾"		57.7					
10:30	29		230	210	207		50	544	570	720	855	695	450	1080	1400	1580	1690	1010	10'-2⅞	0'-10"	0'-2¾"		59.4					Rel
11:00	28		230	210	210		50	544	565	710	860	670	460	1085	1430	1585	1690	1005	10'-2⅞	0'-10'	0'-2¾"		60.1					
11:30	24		220	210	208		50	564	575	698	835	686	500	1080	1400	1580	1670	1000	10-2½	0-10½	0-2⅜	2'-5"	57.9					
12:00	21		220	210	208		50	548	560	710	840	700	500	1080	1420	1565	1630	1005	10-1¾	0-10¾	0-7 7/8	3-5"	54.3					
12:30	21		230	215	210	210	50	560	580	715	855	785	495	1080	1420	1590	1685	1005	10-1⅜	0'-11"	0-3"	1'-7	57.7					Rel
1:00	20		250	235	225	225	50	544	585	720	850	728	500	1080	1430	1600	1705	1005	10-1⅜	0'-11"	0-3"	1'-4"	54.3	353	38.7			
1:30	20		250	235	225	225	50	544	585	720	840	736	470	1080	1430	1605	1710	1005	10'-5⅞	0'-10"	0'-3½"	2'-5½"	54.3					
2:00	20		250	235	225	225	50	540	580	720	850	740	500	1080	1420	1585	1680	1000	10'-4"	0'-11"	0'-3⅜"	3'-7"	54.3					Rel
2:30	21		240	230	220	220	50	530	570	720	855	736	460	1080	1425	1590	1690	1005	Rel	—	—	—	59.4					Rain
3:00	21		250	230	220	220	50	520	560	720	860	733	460	1080	1430	1590	1690	1010	9'-11½"	0'-11½"	0'-3½"	1'-9"	57.0	353				
3:30	23		260	235	230	230	50	570	585	720	860	740	500	1080	1430	1600	1700	1010	9-11½	0-11¾	0-3⅜"	2-4	55.1					
4:00	22		250	235	235	230	50	540	575	710	835	730	485	1080	1420	1590	1690	1000	9-10½	0-11¾	0-3⅜"	5-3	57.7					Released
4:30	18		240	230	225	230	50	575	580	715	855	726	520	1080	1415	1580	1680	1005	9'-10½	1-0	0-4	6-9"	53.7					
5:00	18		250	235	228	240	50	582	590	725	865	740	480	1085	1420	1600	1710	1010	9'-10"	1'-7 1/16	0-4¼	2'-2"	54.3	347	38.2			
5:30			265	245	240	235	50	570	590	725	850	744	520	1080	1420	1600	1705	1010	9-9⅝	1" 3/16"	0'4 3/4	4-2"	54.9					Rel
6:00	36		265	235	240	230	50	662	575	720	845	740	610	1080	1410	1595	1700	1005	9'-8 5/8	1" 1/16"	0'4 5/8	1-7"	52.0					15 Dec
6:30	30		265	240	245	235	50	549	577	715	835	742	500	1080	1405	1590	1690	1000	9-8½	1" 3/16"	0-4¾	2'-2"	53.0					in tank 4
7:00	33		290	230	230	220	50	632	580	695	830	730	500	1070	1400	1690	1605	1000	9-7⅞	1-0¼	0-4½	3-5	54.1	348	38.1			
7:30	33		290	225	225	220	50	532	560	695	826	732	500	1080	1410	1570	1705	1000	9-7¼	1'	0-4	1-2	53.5					Rel
8:00	29		260	220	220	215	50	546	555	690	820	720	470	1050	1405	1580	1695	1000	9-6⅞	1'-1"	0-4½	2'2"	53.8					
8:30	22		250	215	220	215	50	560	565	700	840	720	500	1065	1395	1575	1690	995	9-6⅜	1'-1"	0-5	3-3	53.1					Rel
9:00	22		260	210	215	210	50	570	576	705	845	718	535	1050	1390	1600	1715	985	9'-6"	1'-1⅛	0-5⅛	1'-1"	51.7	345	37.6			
9:30	19		240	205	210	200	50	576	580	700	860	714	490	1005	1400	1600	1720	990	9-5⅞	1-1⅛	0-5½	2'-1"	56.2					
10:00	19		250	225	225	215	50	572	580	716	860	728	490	1070	1410	1600	1720	1000	9-5⅜	1-1½	0-5⅜	3'-3"	53.1					
10:30	19		250	230	230	220	50	578	585	716	860	732	515	1065	1400	1600	1720	1000	9'-5"	1'-1½	0-5½	2'-1"	53.2					
11:00	18		275	250	250	240	50	584	590	726	870	732	530	1075	1405	1600	1710	1000	9-4¾	1'-1½"	0-5⅜	2'-10"	52.4	345	38.4			
11:30	24		255	235	235	230	50	576	595	720	860	744	510	1070	1400	1570	1705	1000	9'-4⅜	1'-1½"	0-5¾	4'-4½"	49.1					Rel

[illegible] No 8 Run 9
Stock: Paraffine Base Gas Oil.
Date 6-27-17 6/28/17
Page 3.
Measured by [illegible]

Final – Measurement 6/25/17
Fire pump supply tank 8'-5 1/4"
Service supply tank 3'-6 1/4"
Distillate 0'-10 3/8"
Gas – 1'-8 3/4"
4 & 5 – Fuel Oil tank 6'-2 1/8"

lost about 8 gals 2583
testing oil meter
during run.

Time	Pump Strokes 1	2	Temperature Degrees F. Pump	Coils Inlet	Coils Outlet	Pressure Coils	Receiver	Coils 2	Coils 3	Coils 4	Coils 5	Vapor	Pressometer Degrees 1	2	3	4	5	Tank Gauges Supply 7'-10"	Tank Gauges Gas	Tank Gauges Distillate	Time meter Found	Gravity Dist.	Gravity	Gravity Res.	Remarks
11:00	26		245	240	245	230	60	566	580	720	860	744	505	1060	1400	1585	1700	1000	9'-4"	1'-1 1/2"	0'-5 1/2"	1'-6"	50.3			
11:30	26		270	235	236	230	50	558	575	710	850	743	530	1055	1295	1590	1700	995	9'-3 1/2"	1'-1 3/4"	0'-6"	2'-11"	57.3			
1:00	26		260	220	220	216	50	556	566	705	850	742	520	1050	1390	1590	1700	995	9'-3 1/8"	1'-1 3/4"	0'-6 1/2"	4'-2"	56.0	34.7	37.6	Rel.
1:30	26		280	215	216	210	50	560	566	705	850	742	520	1050	1390	1590	1700	995	9'-2 5/8"	1'-1 3/4"	0'-6 3/4"	1'-4 1/2"	57.8			
2:00	26		260	210	210	206	50	564	575	700	850	742	500	1050	1390	1600	1710	995	9'-2 1/4"	1'-1 3/4"	0'-6 1/2"	2'-7 1/2"	50.6			
2:30	26		245	195	195	190	50	576	580	700	855	744	510	1050	1390	1600	1700	995	9'-2"	1'-2"	0'-6 5/8"	3'-11"	60.5			Rel.
3:00	26		240	215	215	210	50	574	580	721	870	742	490	1050	1390	1600	1710	995	9'-1 7/8"	1'-2"	0'-7 1/4"	1'-1"	57.0	34.3	37.7	
3:30	26		245	220	220	215	50	578	585	726	870	744	500	1050	1390	1600	1720	995	9'-1 3/8"	1'-2"	0'-7 3/4"	2'-[illegible]	[illegible]			
4:00	26		245	220	220	215	50	582	595	726	875	748	500	1040	1400	1600	1710	1000	9'-1 1/8"	1'-[illegible]	0'-7 3/4"	4'-[illegible]	51.0			
4:30	27		245	230	225	220	50	588	590	730	880	740	490	1050	1400	1605	1730	1000	9'-7/8"	1'-2 1/4"	0'-7 1/4"	1'-4 1/2"	49.8			Rel.
5:00	26		240	245	240	240	50	580	595	730	880	734	490	1050	1400	1600	1730	1000	9'-1/2"	1'-2 1/2"	0'-8 1/4"	3'-5"	49.7	33.0	37.2	Rel.
5:30	31		245	240	240	235	50	582	580	725	880	728	490	1060	1400	1600	1730	1000	9'-0"	1'-2 3/8"	0'-8 1/2"	2'-1/2"	50.2			
6:00	29		245	230	230	230	50	548	545	745	895	706	520	1060	1405	1620	1735	1000	8'-11"	1'-2 1/2"	0'-8 1/4"	3'-5"	50.7			Rel.
6:30	28		245	230	225	225	50	550	560	700	848	746	530	1070	1410	1610	1740	1000	8'-10 1/8"	1'-2 3/4"	0'-8 3/4"	1'-10"	50.8			
7:00	26		245	235	240	230	50	552	570	710	855	744	510	1060	1400	1605	1730	1000	8'-10 1/2"	1'-2 7/8"	0'-9"	3'-0"	51.2	33.1	36.6	
7:30	25		245	215	220	215	50	556	560	700	830	745	490	1060	1400	1600	1735	995	8'-10"	1'-3 1/8"	0'-9 1/4"	5'-8 1/2"	54.4			Released
8:00	26		245	210	210	210	50	540	560	690	840	740	500	1060	1360	1550	1645	965	8'-9 5/8"	1'-3 3/8"	0'-9 1/4"	4'-4"	54.8			
8:30	28		250	215	220	210	50	540	560	700	850	740	450	1060	1390	1590	1720	980	8'-9 1/2"	1'-3 3/8"	0'-9 1/4"	3'-5 1/2"	56.4			
9:00	31		235	200	210	206	50	530	560	695	835	745	490	1060	1370	1565	1690	985	8'-8 3/4"	1'-4"	0'-9"	2'-10"	58.4	33.0	37.4	
9:30	32		245	208	210	205	50	535	550	690	835	734	460	1060	1360	1560	1690	980	8'-8 1/2"	1'-4 3/8"	0'-9 1/2"	4'-1"	59.2			Rel.
10:00	32		240	200	205	200	50	536	550	695	835	739	500	1050	1370	1575	1700	980	8'-7/8"	1'-4 1/2"	0'-9 1/4"	1'-6 1/2"	57.9			10,000 m
10:30	26		225	200	200	195	50	552	560	685	840	740	450	1050	1390	1600	1720	975	8'-7 3/8"	1'-5"	0'-9 3/4"	2'-2"	57.9			Rel.
11:00	24		210	190	200	195	50	552	570	690	845	735	460	1060	1400	1600	1740	980	8'-7 1/4"	1'-5"	0'-9 7/8"	2'-1 1/2"	51.8	33.3	37.9	Jan.
11:30	24		220	195	200	195	50	565	575	690	845	740	500	1060	1395	1595	1720	990	8'-6 3/4"	1'-5 1/8"	0'-9 1/8"	3'-10"	55.6			27.10 27.19
12:00	24		215	190	200	190	50	565	575	690	850	740	500	1060	1410	1630	1780	1000	8'-6 5/8"	1'-5 1/8"	0'-9 1/8"	4'-11"	55.7			Released
	26																								

Acct. from 12:00 m 6/28/17

Page 3.

Distillate Gas — 4 v 35 — Fuel Oil tank 16'6-2⅛"

0-1078
1-874

testing during run.

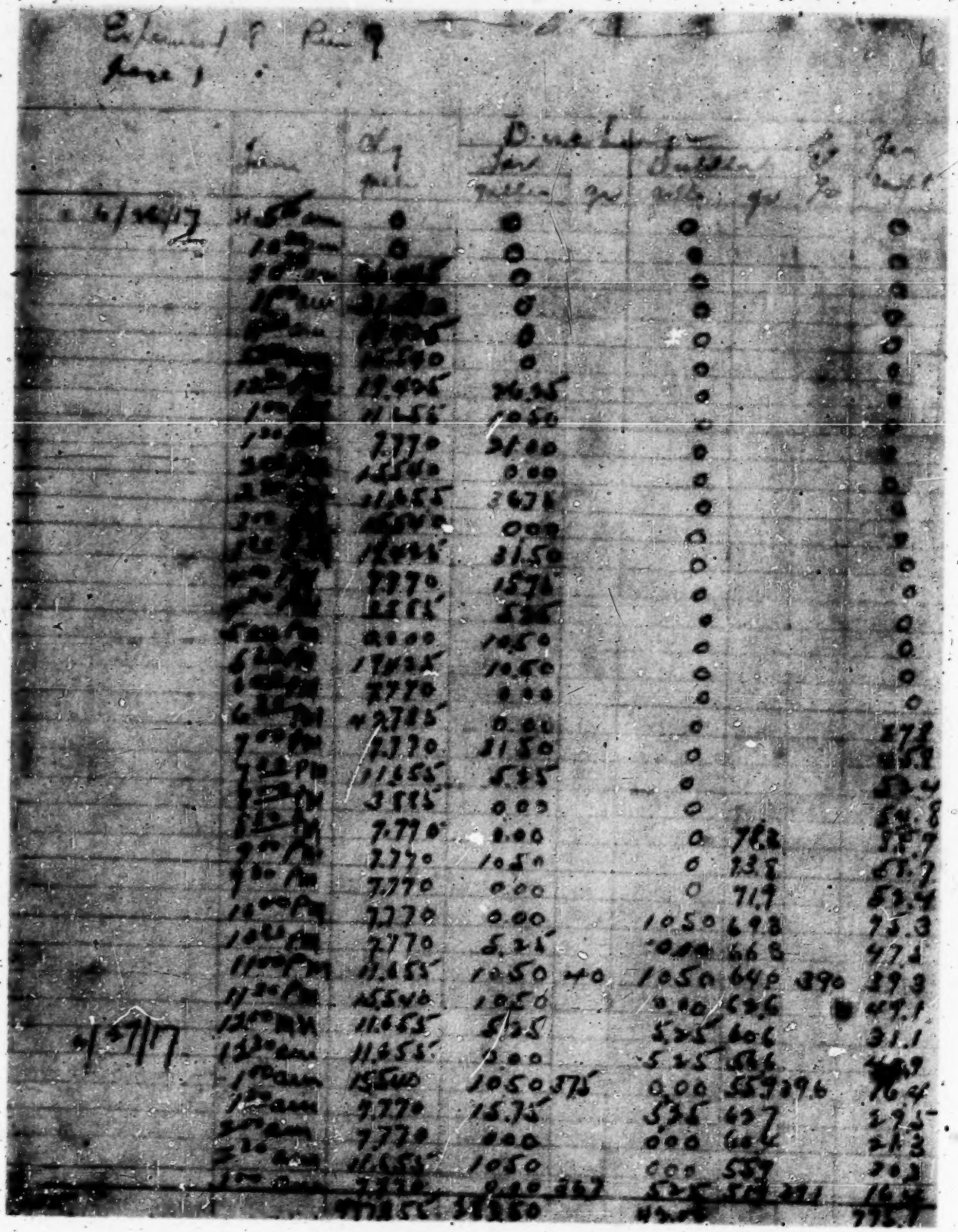
Time	Pump Strokes 1	Pump Strokes 2	Temperature Abs. F. Pump	Cast Front	Cast Back	Room	Rec.	Temperature Abs. F. Coils 2	3	4	5	Room	Vapor	Pyrometer Degrees F. 1	2	3	4	5	Tank Gauges Supply 7710	Jar	Outside	Gas over Tank	Gravity Dist.		Bottom	Remarks
Nic J 12:00	26		275	240	245	230	50	566	580	720	850	744	500	1060	1400	1585	1700	1000	9'-4"	2-1½"	0-5½	1'-6"	50.2			
5-28-17 12:30	26		270	235	236	230	50	558	575	710	860	742	530	1050	1395	1590	1700	995	9'-3½	1-1¾	0-6	2'-11"	57.3			
am 1:00	26		260	220	220	216	50	554	566	705	850	742	520	1050	1390	1590	1700	995	9-3⅛	1-1¾	0-6½	4'-2"	57.0	34.7	37.6	Rel.
V 1:30	26		280	215	215	210	50	560	566	705	850	742	520	1050	1390	1590	1705	995	9-2⅝	1-1¾	0-6½	1'-4½	57.8			
V 2:00	26		260	210	210	206	50	564	575	700	850	742	500	1050	1390	1600	1710	995	9-2¼	1-1¾	0-6½	2'-7½	50.6			
2:30	26		275	195	195	190	50	570	580	700	855	744	510	1050	1390	1600	1700	995	9-2"	1-2"	0-6⅞	3'-11"	60.5			Rel.
3:00	26		240	215	215	210	50	574	580	720	870	742	490	1050	1390	1600	1710	995	9-1⅞	1-2"	0-7⅛	1'-5"	57.0	34.3	37.7	
3:30	26		245	220	220	215	50	578	586	720	870	744	500	1050	1390	1600	1720	995	9-1⅞	1-2⅛	0-7⅛	2'-[illegible]	[illegible]			
4:00	28		245	220	220	215	50	582	595	725	875	748	500	1040	1400	1600	1710	1000	9-1⅛	1-2⅛	0-7⅛	4'-2"	51.0			Rel.
4:30	27		245	230	225	220	50	588	590	730	880	746	490	1050	1400	1605	1730	1000	9'-⅞"	1-2⅛	0-7½	1'-4½	49.8			
5:00	26		260	245	240	240	50	580	595	730	880	734	490	1050	1400	1600	1730	1000	9'-½"	1-2¼	0-8⅛	3'-5"	49.7	33.0	37.0	Rel.
V 5:30	31		275	240	240	235	50	582	580	720	850	720	520	1060	1400	1600	1730	1000	9'-0"	1-2⅜	0-8⅞	2'-1"	50.2			
V 6:00	29		275	230	230	230	50	548	575	705	845	706	520	1060	1405	1620	1735	1000	8'-11"	1-2½	0-9⅛	3'-5	50.7			Rel.
V 6:30	26		275	230	225	225	50	550	562	700	848	746	530	1070	1410	1610	1740	1005	8'-10⅞"	1-2¾	0-8⅞	1'-10"	50.8			
V 7:00	26		265	235	240	230	50	552	570	710	855	744	510	1070	1400	1605	1730	995	8'-10⅝"	6-2⅝	0'-9"	3'-0"	51.3	33.1	36.6	
7:30	25		245	215	220	215	50	546	560	702	830	745	490	1060	1350	1500	1735	995	8'-10	1'-5⅛	0'-9¼	5'-4½"	54.4			Released
8:00	26		245	210	210	210	50	540	560	690	840	740	500	1040	1360	1550	1645	965	8'-9⅝	1'-3¾	0'-9¼	4'-4"	54.8			
8:30	29		250	215	220	210	50	540	560	700	850	740	450	1050	1390	1590	1720	980	8'-9½"	1'-3⅝	0'-9⅜	2'-5½"	56.4			
9:00	31		245	200	210	206	50	530	560	695	835	745	490	1040	1370	1565	1690	985	8'-8¾"	1'-4"	0-9⅝	2'-10"	58.4	33.0	37.4	
9:30	32		245	208	210	205	50	525	550	690	835	734	460	1040	1360	1560	1690	980	8-8⅝	1-4⅜	0-9½	4'-1"	59.-			Rel.
10:00	25		260	200	205	200	50	536	550	685	835	739	500	1045	1370	1575	1705	980	8-7⅞	1-4½	0-9⅝	1'-6½	57.9			10:00 a.m.
10:30	26		225	200	200	195	50	552	560	685	840	740	450	1050	1390	1600	1720	995	8-7⅞	1'-5"	0-9⅝	2'-2"	57.9			Gave [illegible]
11:00	24		210	190	200	195	50	552	570	690	845	735	460	1060	1400	1600	1740	980	8-7½	1'-5"	0-9⅝	2'-7½"	51.8	33.3	37.9	Jar [illegible]
11:30	24		220	195	200	195	50	565	575	690	845	740	500	1060	1395	1595	1720	990	8-6¾	1-5⅛	0-9⅝	3'-10"	55.6			12:10 29.19"
12:00	24		215	190	200	190	50	565	575	690	850	740	500	1060	1410	1630	1780	1000	8-6⅜	1-5¼	0-9⅜	4'-1"	55.7			Released
	26		Quit					Steam	12:00	m.	6/28/17														
12:30	21		160	150	150	148	50	548	570	680	780	720	510	940	1180	1165	1320	910	8'-6"	1-5½	0-10	1'-1"	52.3			
1:00	21		105	105	110	115	50	525	550	635	715	690	488	938	1025	1140	1185	850	8'-5⅞	1'-5⅞	0-10½	1'-5"	52.4			
1:30	15		25	75	80	80		520	535	645	685	655	450	880	1000	1040	1070	800				1'-7½	52.3	Rel.	Jenn	Closed Steam Valve
																									Down at 2:00
																		Dark	8-5¼	1-8¾	0-10⅞				

8-9.

	Stock	Baltimore	Pittsburg
9	38.0	38.9	35.7
11	163	175	120
12	310	205	205
100	97/100	92/100	94/100 ?
[illegible]			
2	200	200	200
4	390	400	310
10	454-42.2	422-41.3	440-44.4
20	476-40.7	430-40.9	468-40.1
30	490-39.9	438-40.6	486-39.0
40	502-39.5	446-40.3	502-38.0
50	514-38.9	456-39.7	518-37.1
60	530-38.1	466-39.4	534-36.4
70	546-37.4	478-38.6	554-35.6
80	560-36.6	492-38.1	584-34.4
90	590-35.5	516-37.4	626-32.1
95	618 —	544 —	
85	666-33.7	584-36.5	
To Rec			

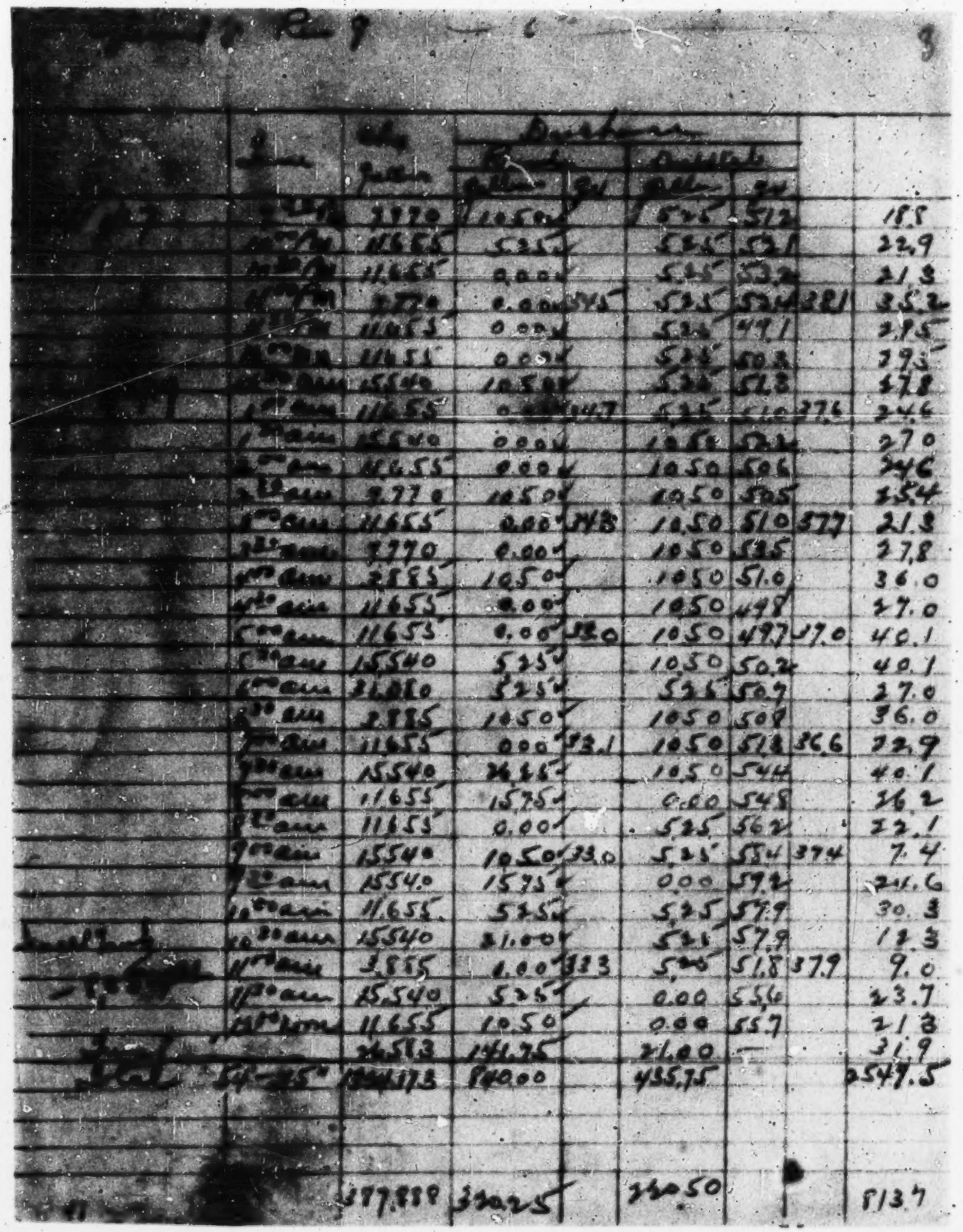
24
14
38
266
518

44



Bkf 8 Rm 9
Page 2

	Time	Casing Pressure	Orifice Reading Diff.	Orifice Diff.	Temp.	Gas MCF
9/27/17	3 PM	7770	0.00	0.00	554	24.6
	4 PM	7770	0.00	5.25	554	28.57
	5 PM	11655	0.00	5.25	557	28.6
	6 PM	11655	10.50 34.8	10.50	555	38.9
	7 PM	7770	0.00	10.50	555	32.7
	8 PM	3885	0.00	0.00	554	17.2
	9 PM	11655	10.50	5.25	556	16.23
	10 PM	7770	10.50 35.4	0.00	559	32.0
	11 PM	15540	0.00	5.25	560	29.8
	12 PM	15540	0.00	5.25	563	5.4
	1 AM	23310	5.25	10.50	565	2.9
	2 AM	19425	15.75 [illegible]	[illegible]	[illegible]	[illegible]
	3 AM	11655	10.50	0.00	564	1.8
	4 AM	15540	10.50	5.25	567	9.7
	5 AM	11655	31.50	5.25	571	27.8
	6 AM	15540	0.00 [illegible]	[illegible]	[illegible]	[illegible]
	7 AM	7770	10.50	5.25	579	18.14
	8 AM	11655	26.25	0.00	582	7.8
	9 AM	11655	5.25	5.25	587	2.3
	10 AM	15540	0.00 25.3	5.25	0.8	[illegible]
	11 AM	7770	5.25	5.25	592	[illegible]
	12 PM	11655	10.50	5.25	596	[illegible]
	1 PM	—	—	—	—	—
	2 PM	23310	5.25 25.3	5.25	599	2.0
	3 PM	11655	10.50	5.25	557	2.1
	4 PM	19425	5.25	10.50	567	4.0
	5 PM	7770	5.25	5.25	536	1.8
	6 PM	7770	3.625 34.7	5.25	548	25.2
	7 PM	11655	13.125	5.25	548	4.5
	8 PM	23310	5.250	10.50	520	2.2
	9 PM	11655	10.50	5.25	530	1.9
	10 PM	15540	0.00 34.8	0.00	541	38.1
	11 PM	19425	5.25	0.00	545	2.4
	12 PM	15540	5.25	10.50	528	2.0
	1 AM	11655	0.00	5.25	521	1.8
	2 AM	11655	5.25 34.5	5.25	517	1.6
46			458.430	36.25	178.26	



Experimental 8 Run 9

Summary:

Time of Run from beginning to End 54 hrs 45 min

Feed charged 265.56 gallons

Stock	1324.173 gallons	100%	
Distillate	435.75 gallons	32.91	
Residue	840.00 gallons	63.44	
Gas	2549.5	48.422 "	3.65
Carbon	not determined		
Leakage			

Fractional Distillation of Distillate 9500 cc 518 gr

Info from mineral oil stones in all towers

	%	gr.	
Naphtha to 350	48.72	252	
Naphtha to 375	54.33	57.1	
abv Naphtha	2.68		
Bottoms above 375	39.20	38.9	
Loss Distilling	1.79		

Total Distillate = Stock Less Bottoms above 375 (Naphtha to 350 + Naphtha to 375) (Difference)

Yield & Product by volume Base stock

		gallons	%	gr.
Distillate: 32.91	Naphtha to 350	312.4	16.04	59.2
	Naphtha to 375	245.4	18.54	57.1
	abv Naphtha	11.65	0.88	
	Bottoms above 375	170.9	12.90	38.9
	Loss Distilling	7.8	0.59	
Residue		840.0	63.44	
Gas	2549.5 cu ft	48.422	3.65	
Carbon	not determined			
Leakage	not determined			

Ca. 8 9

182-90

	Slack	Blend	Full
Sur-	48.2	51.4	24.4
Slack	-60	-60	140
Yarn	-60	-60	195
Use	29/100	25/100	34/100
Comp		0	
Ae	200	200	200
At	382	116	282
10	452 438	206 - 71.0	436 - 452
20	478 467	254 - 64.5	474 - 40.3
30	490 399	294 - 67.2	486 - 39.1
40	506 391	326 - 59.4	508 - 39.7
50	518 385	366 - 49.1	522 - 39.0
60	532 382	400 - 44.3	536 - 38.8
70	546 378	432 - 42.6	552 - 38.9
80	566 364	466 - 40.2	574 - 34.8
90	600 351	528 - 39.3	610 - 32.4
95	624		626
Ls		5%	
% Ret	95%	92%	99%

2596

Page 1

	11:00	11:30	12:00	12:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00
	Dep	Dep	Dep	Dep	Dep	Dep	Dep	Dep	Dep	Dep	Dep	Dep	Dep
0	640	406	890	659	375	394	519	36.7	891	654	824	824	824
1	98	274	270	100	282	266	408	276	266	104	352	344	344
5	170	346	346	176	344	276	156	266	958	468	414	966	966
10	164	406	400	168	416	362	190	414	396	398	434	396	396
15	166	438	434	200	460	386	232	442	402	306	452	446	446
20	184	456	448	224	458	406	250	430	416	328	464	430	430
25	198	468	458	240	472	422	272	474	426	350	476	440	440
30	214	480	466	256	484	436	296	486	436	366	486	449	449
35	228	490	478	270	496	446	312	492	444	388	496	456	456
40	236	500	486	290	500	456	330	500	456	408	504	464	464
45	250	508	496	312	506	466	348	510	464	426	512	470	470
50	266	514	502	324	514	470	364	518	472	446	520	478	478
55	278	520	508	346	520	478	380	526	478	464	526	486	486
60	300	528	516	370	528	486	400	536	490	484	536	496	496
65	320	536	524	392	536	492	422	542	498	502	544	504	504
70	342	546	534	414	546	502	436	552	506	516	556	508	508
75	358	556	546	438	556	512	452	562	514	530	568	516	516
80	416	568	558	460	566	520	470	574	524	550	586	528	528
85	460	578	570	484	582	534	496	596	536	572	614	544	544
90	—	600	584	518	606	534	524	610	548	504	636	558	558
95	—	634	622	—	640	580		652	570		670	594	594
98	—	668	—	—	670	604	536	—	582	526	—	632	632
98 Rec	65	99	92	91	99	99	92		99	92	95	98	98

2597

Page 2

Sample Lot 9 ... 29 1917

	7 ann			9 ann			11 Class.			1 Prize		
	Dist	Lin	B Trap	Dist	Lin	B Trap	Dist	Lin	B Trap	Dist	Lin	B Trap
6/27/17	58.5	35	32.5	55.1	[illegible]	39.2	60.1	35.4	39.4	52.3	35.3	38.7
[illegible]	104	304	318	[illegible]	318	318	102	306	336	150	324	332
5	262	392	370	186	392	378	160	390	376	176	400	352
10	320	426	396	166	426	400	166	402	400	206	402	400
15	298	448	416	194	430	418	194	438	420	238	456	418
20	376	470	438	222	470	436	216	476	402	268	432	432
25	448	492	460	244	480	436	232	452	460	290	488	462
30	460	492	468	256	488	444	240	496	462	306	496	462
35	476	498	456	278	496	456	258	500	458	324	502	464
40	398	506	460	296	502	462	276	506	466	342	508	470
45	312	514	468	316	510	468	292	514	476	362	514	476
50	375	522	476	332	518	476	310	520	482	380	520	482
55	326	530	484	354	524	484	326	526	488	398	530	490
60	364	536	492	368	534	492	342	536	494	414	538	496
65	390	544	500	392	544	500	360	544	500	430	546	502
70	405	554	506	408	550	506	388	554	506	434	556	512
75	430	466	514	416	558	516	401	566	514	458	566	522
80	456	580	524	432	582	526	402	580	526	472	584	532
85	488	608	536	464	604	538	468	594	540	490	606	548
90	-	622	552	510	630	556	-	620	554	516	616	560
95	-	-	570	-	646	588	-	618	570	-	-	556
Ex	-	-	594	518	-	630	486	-	608	524	-	-
96 Pts	89½	-	99½	-	95	98	89		99	90½	-	-

2599

6/27/17 Page 3 Sample Lot 9.

	3 Pm	3 Pm	3 Pm	5 Pm	5 Pm	5 Pm	7 Pm	7 Pm	7 Pm	9 Pm	9 Pm	9 Pm
	Oil	Air	Bl	Oil	Air	Bl	Oil	Air	Bl	Oil	Air	Bl
	599	253	359	543	854	362	541	348	381	517	345	370
1	125	320	816	170	394	216	106	280	930	108	295	674
5	166	412	396	136	476	357	164	398	990	166	350	378
10	192	458	296	156	476	408	190	438	916	204	430	410
15	214	476	452	206	436	430	218	456	936	226	450	426
20	238	486	430	252	450	448	242	476	946	266	470	440
25	258	492	440	273	470	460	266	486	958	296	486	450
30	270	498	446	296	476	466	284	496	1162	318	497	460
35	286	506	458	318	473	472	304	506	976	338	506	468
40	306	510	472	326	510	478	322	514	980	358	510	472
45	318	516	480	342	512	488	344	518	986	350	518	482
50	340	520	485	356	570	496	366	528	996	376	526	492
55	358	524	494	374	522	502	384	538	952	410	534	498
60	376	532	502	408	526	508	394	544	960	426	538	506
65	400	540	508	428	548	514	420	554	916	440	550	510
70	428	545	518	446	558	528	432	562	926	450	560	516
75	462	560	526	462	568	534	448	574	940	470	574	524
80	498	576	532	464	580	540	466	590	946	496	590	532
85	514	596	546	514	606	550	494	610	956	520	608	544
90	-	602	564	-	620	550	520	624	962	-	652	560
95	-	634	600	-	700	600	-	700	968	-	700	600
100	536	771	688	630	770	686	520	708	1000	536	708	614
40	12	99	97	88	96	98	90	99	97	51	96	48

2601

Page 4 of 17

6/27/17 Bath Tub Samples Coil 9

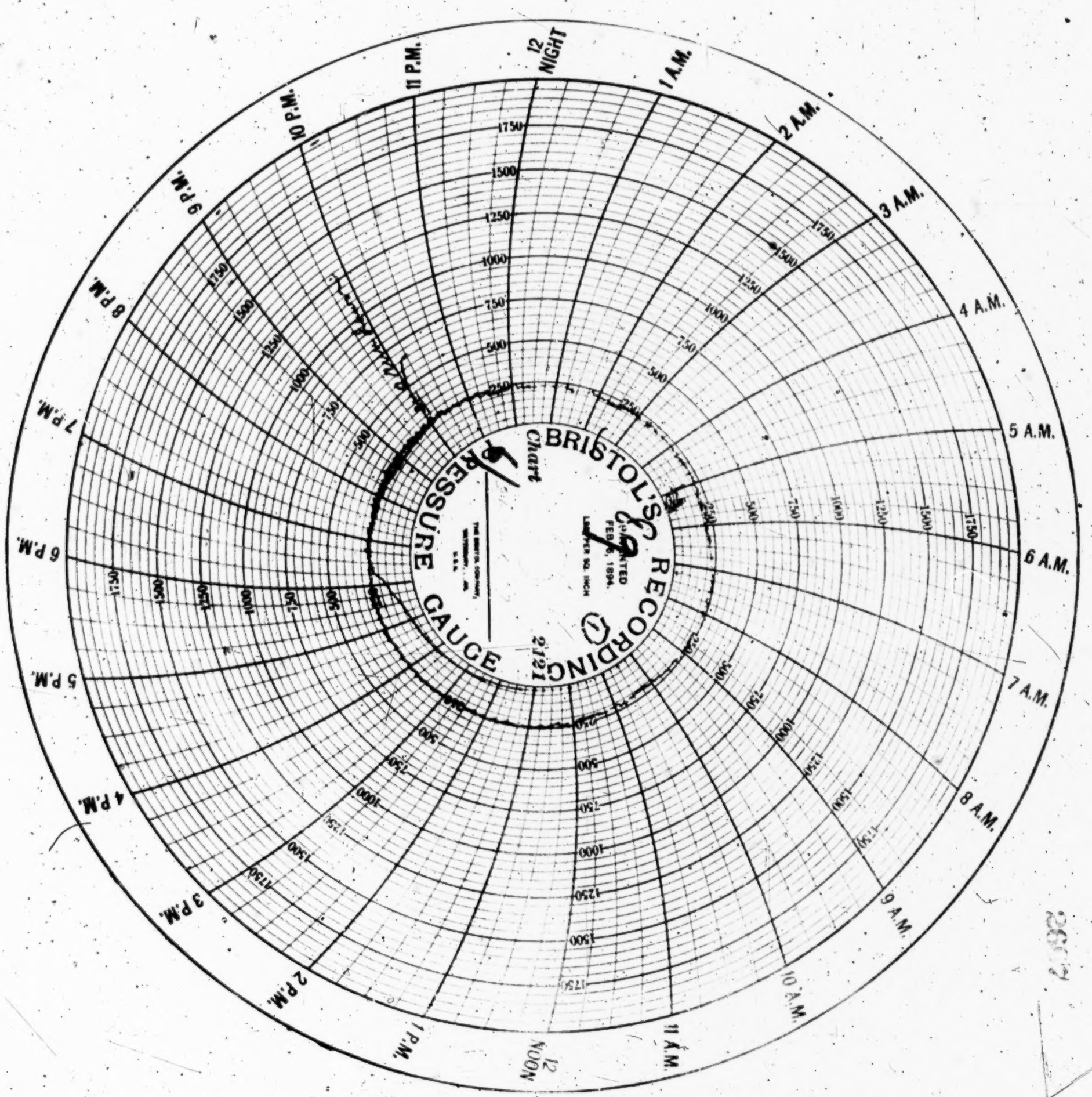
	11 PM			1 AM			3 AM			5 AM		
	Dist	Tar	BT	Dist	Tar	BT	Dist	Tar	BT	Dist	Tar	BT
	[illegible]	34.5	37.1	670	34.1	37.6	57.0	34.3	37.1	49.7	35.0	37.0
St	110	318	326	118	334	372	116	3[illegible]	326	130	378	374
5	172	400	380	222	444	390	164	390	370	182	386	380
10	216	426	428	240	456	400	222	420	416	206	440	440
15	284	450	438	266	500	426	232	456	426	238	465	428
20	266	470	446	290	538	446	266	446	450	252	490	458
25	290	484	456	318	576	434	294	458	458	304	508	468
30	312	494	464	235	532	446	310	496	468	342	510	478
35	[illegible]	502	472	360	580	454	336	506	478	360	514	488
40	354	510	478	356	550	458	354	514	480	366	538	488
45	372	516	486	400	562	472	376	520	486	368	528	498
St 50	394	526	490	444	576	484	392	530	492	390	538	508
55	410	534	498	432	586	488	406	536	498	400	548	508
60	428	540	506	444	602	512	424	540	508	420	554	518
61	434	550	512	456	680	520	444	554	518	444	562	528
70	448	560	516	468	682	528	458	560	528	452	576	538
75	462	568	524	484	675	530	460	574	538	470	576	538
80	478	582	532	500	685	536	482	586	536	488	588	548
85	492	600	538	520	705	548	504	610	554	506	612	558
90	530	616	546	—	706	570	530	636	558	528	638	568
105	—	634	582	—	—	600	—	628	598	—	648	578
Ex 0	530 (715)	720	612	560	716	611	538	720	616	642	712	628
C & R.	92	99	99	98	93	97	98	99	99	97	98	97

2603

Cal 9 6/28/17 100 cc Distillation of Product 15

	Yam Last	Yam Sta	Yam Bta	Yam Dia	Yam Bta	Yam Bta	Ham Dia	Ham Sta	Ham Bta	Ham Bta	Ham Bta	Pa	Pa
	57.3		56.6	58.4	56	37.4							
SX	1X	250	3X	402	368	306	110	490	392				
5	1X6	35X	37X	42X	340	36X	158	392	390				
10	19X	42X	40X	420	440	39X	200	436	400				
15	2X5	45X	4X2	438	470	4X6	238	460	42X				
20	25X	47X	47X	22X	48X	43X	266	47X	42X				
25	3X2	48X	44X	2XX	49X	44X	288	48X	446				
30	32X	49X	45X	2XX	304	45X	308	49X	458				
35	33X	50X	46X	22X	512	46X	326	49X	46X				
40	35X	510	47X	23X	518	46X	354	50X	470				
45	376	518	4X2	3XX	52X	47X	368	512	476				
50	39X	526	48X	32X	534	48X	38X	520	48X				
55	4XX	536	49X	-	54X	48X	400	526	488				
60	42X	54X	50X	362	55X	49X	4X6	532	49X				
65	44X	55X	50X	38X	562	500	430	540	500				
70	45X	566	51X	40X	570	506	44X	550	4XX				
75	4XX	578	52X	42X	58X	514	450	56X	516				
80	48X	606	536	44X	598	524	470	580	526				
85	500	624	548	46X	616	536	488	604	538				
90	52X	65X	56X	49X	648	550	516	626	552				
95	—	—	586	—	-	370	-	-	57X				
EP	540	-	-	600	-	620	530	-	60X				
% Tot	97	-	99	90	-	99%	97		94%				

2605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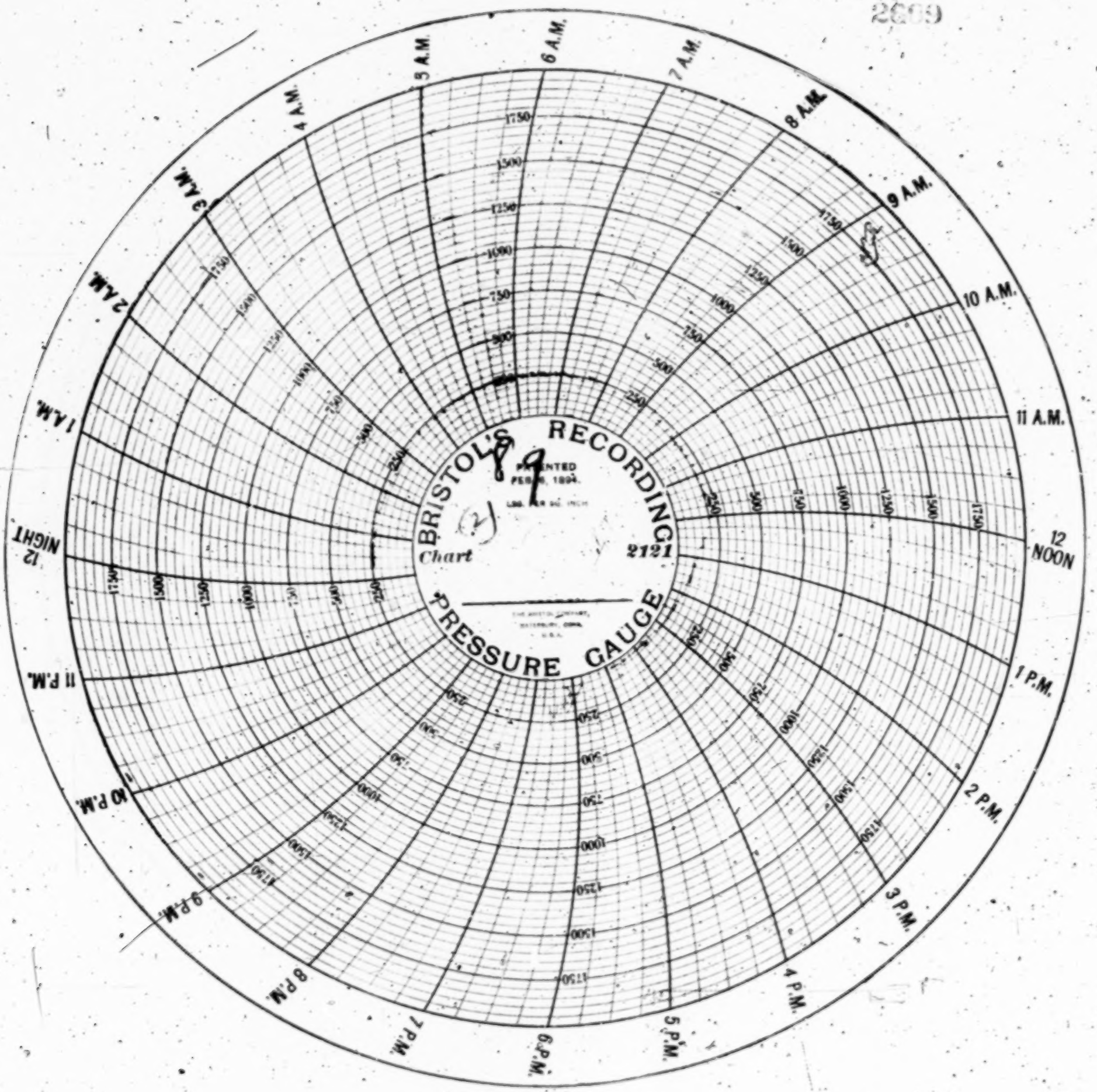
RECORDING
PRESSURE
GAUGE
Chart
12 NIGHT
1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
6 A.M.
7 A.M.
8 A.M.
9 A.M.
10 A.M.
11 A.M.
12 NOON
1 P.M.
2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
9 P.M.
10 P.M.
11 P.M.
1750
1500
1250
1000
750
500
250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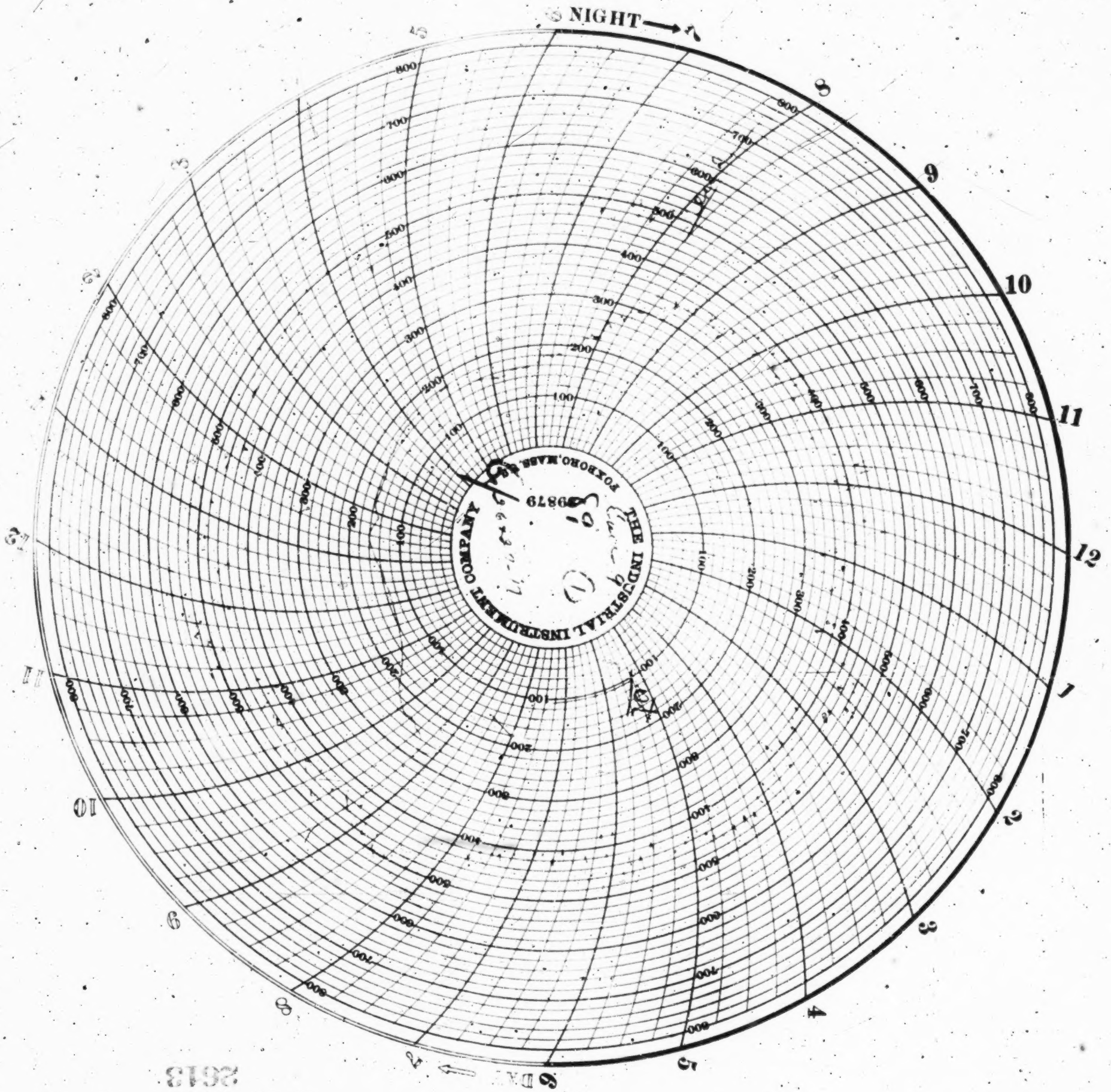
PRESSURE GAUGE
Chart
2121
12 NIGHT
1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
6 A.M.
7 A.M.
8 A.M.
9 A.M.
10 A.M.
11 A.M.
12 NOON
1 P.M.
2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
9 P.M.
10 P.M.
11 P.M.

NIGHT

THE INDUSTRIAL INSTRUMENT CO.
FOXBORO, MASS. U.S.A.
89879


NIGHT
DAY
FOXBORO, MASS. U.S.A.
THE INDUSTRIAL INSTRUMENT COMPANY
9879
800
700
600
500
400
300
200
100
1
2
3
4
5
6
7
8
9
10
11
12

Cont 5 5/28/17 189

5000 ee Distillate / block

21 Hours 8.55 avg

Time	1st	2nd	3rd	Hourly
1150	192	410	456	510
1235	350	440	468	510
1237	355	442	469	511
1240	360	444	470	510
1243	365	445	471	511
1246	370	446	472	512
1248	375	448	473	514

	ee	gi	ev
Night H 1350	139	256	506
2 Hill 1350 – 371	67	134	452
Night H 1350	193	390	486
Hill 1350 – 375	4790	9580	372
Total	4993	9970	

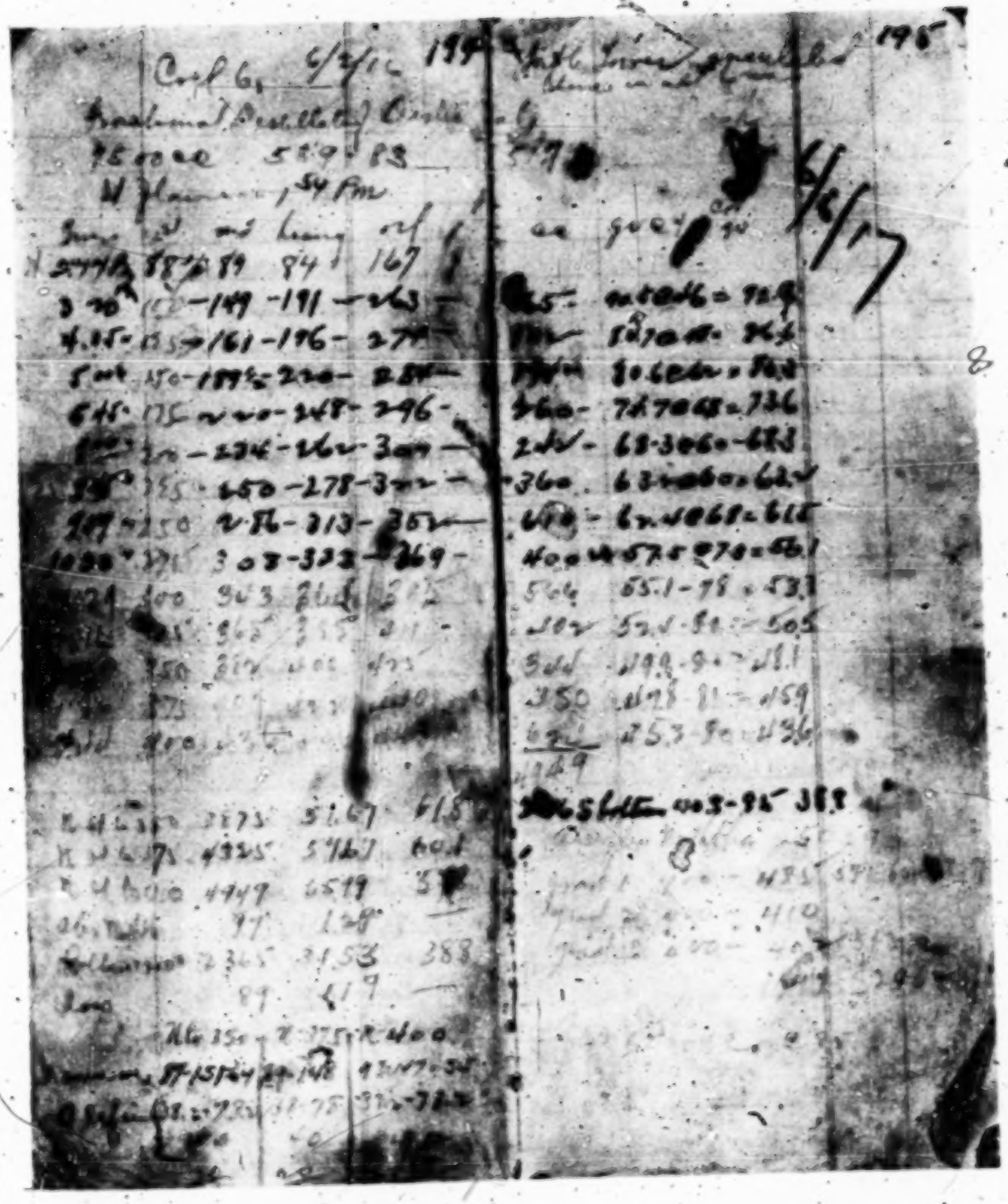
M 189

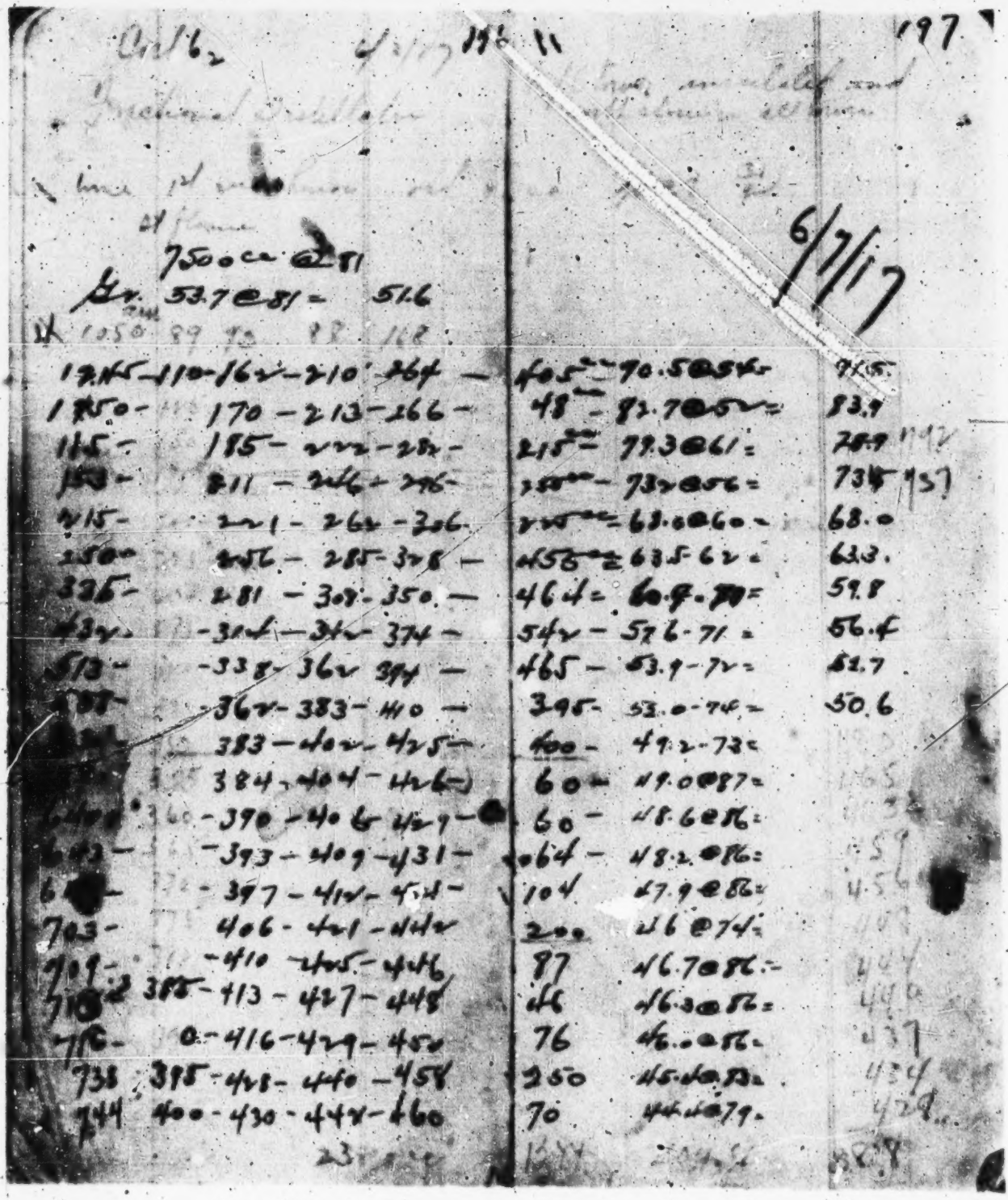
left column with insulation
with thermal bowl

gi 377

ee	gi	ev	
138	531 – 25	506	510-86
14			486
12			
15	6712		
13½	473-84 – 452		
12½			
Dist			

EX 180



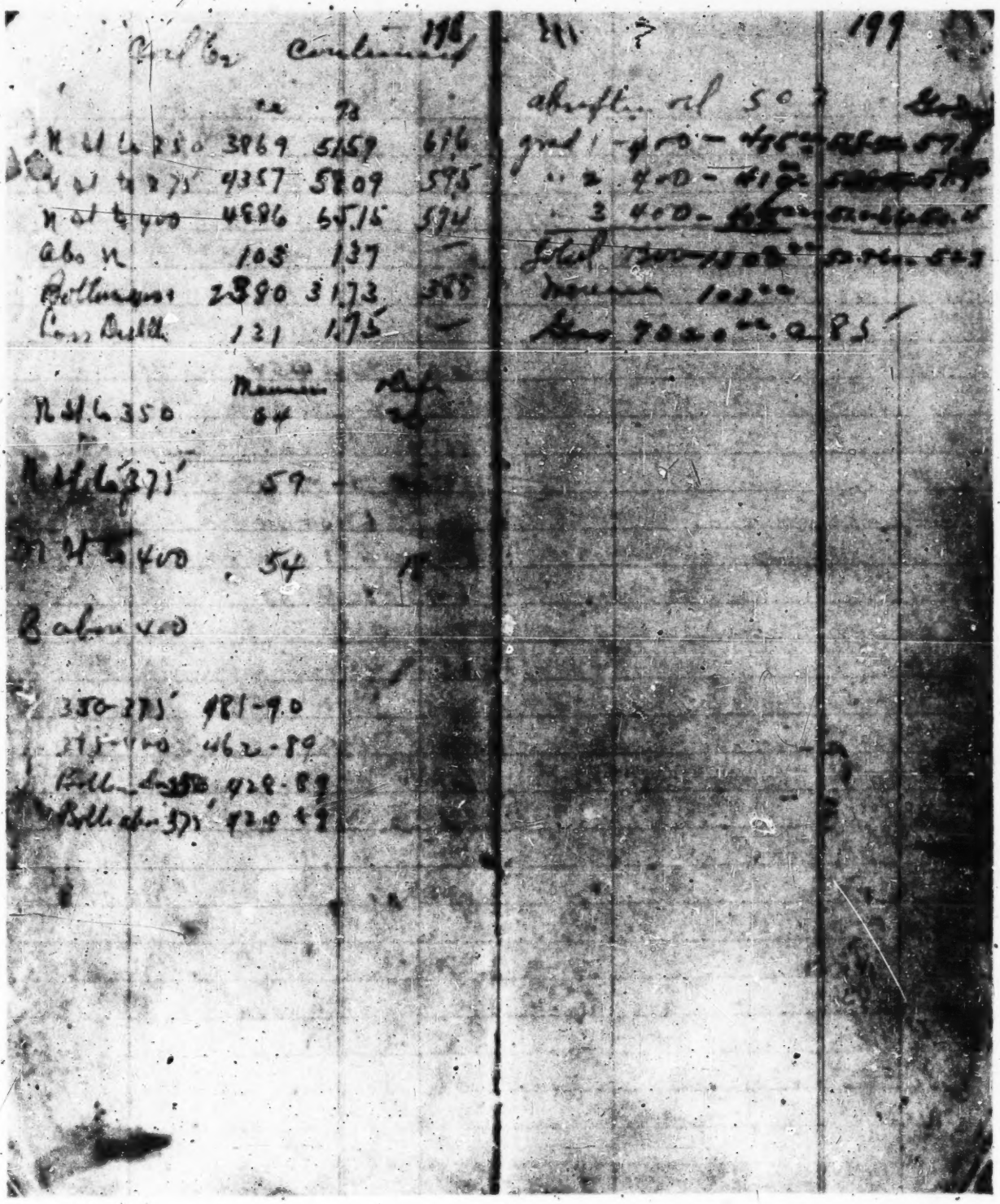


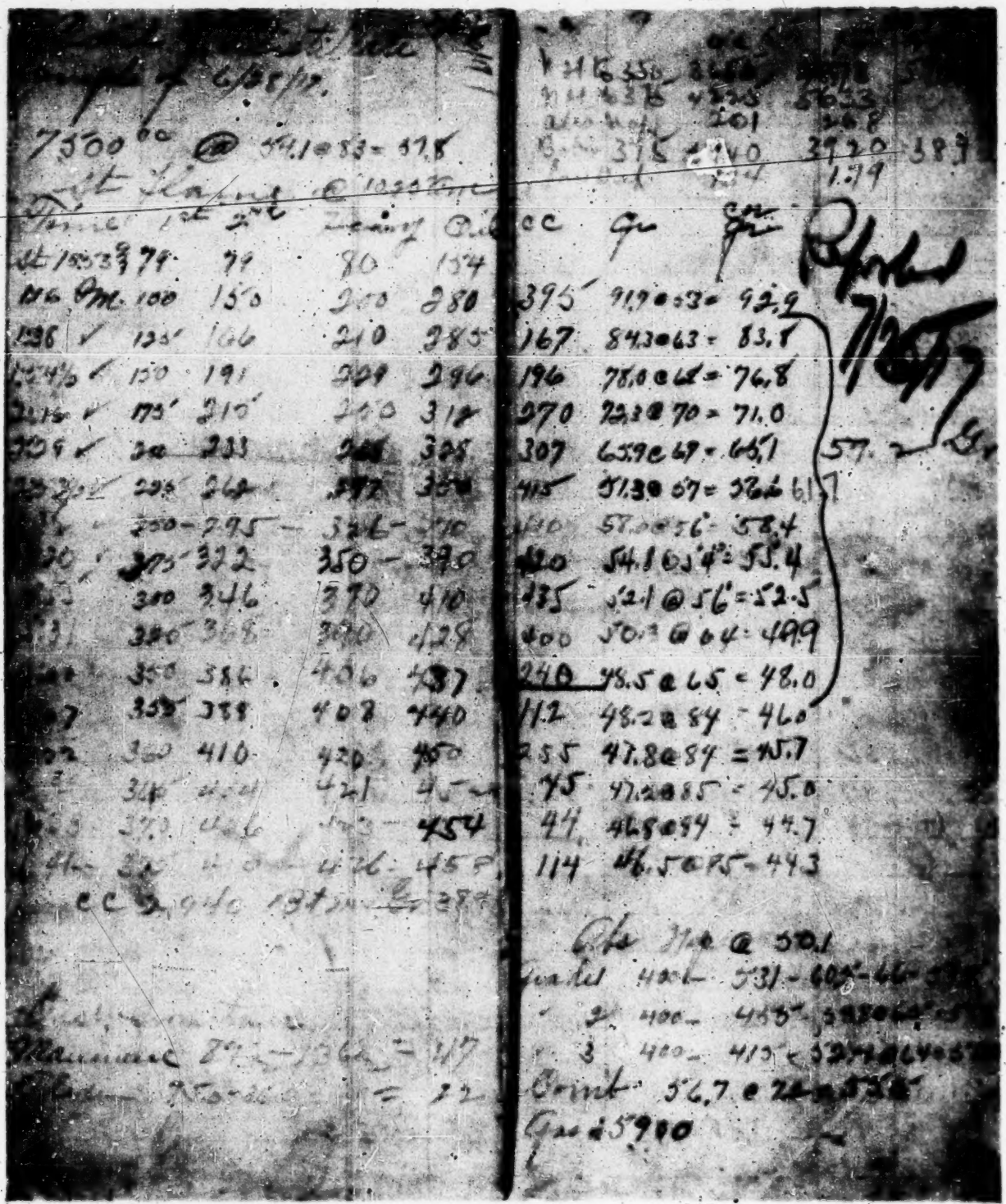
6/7/17

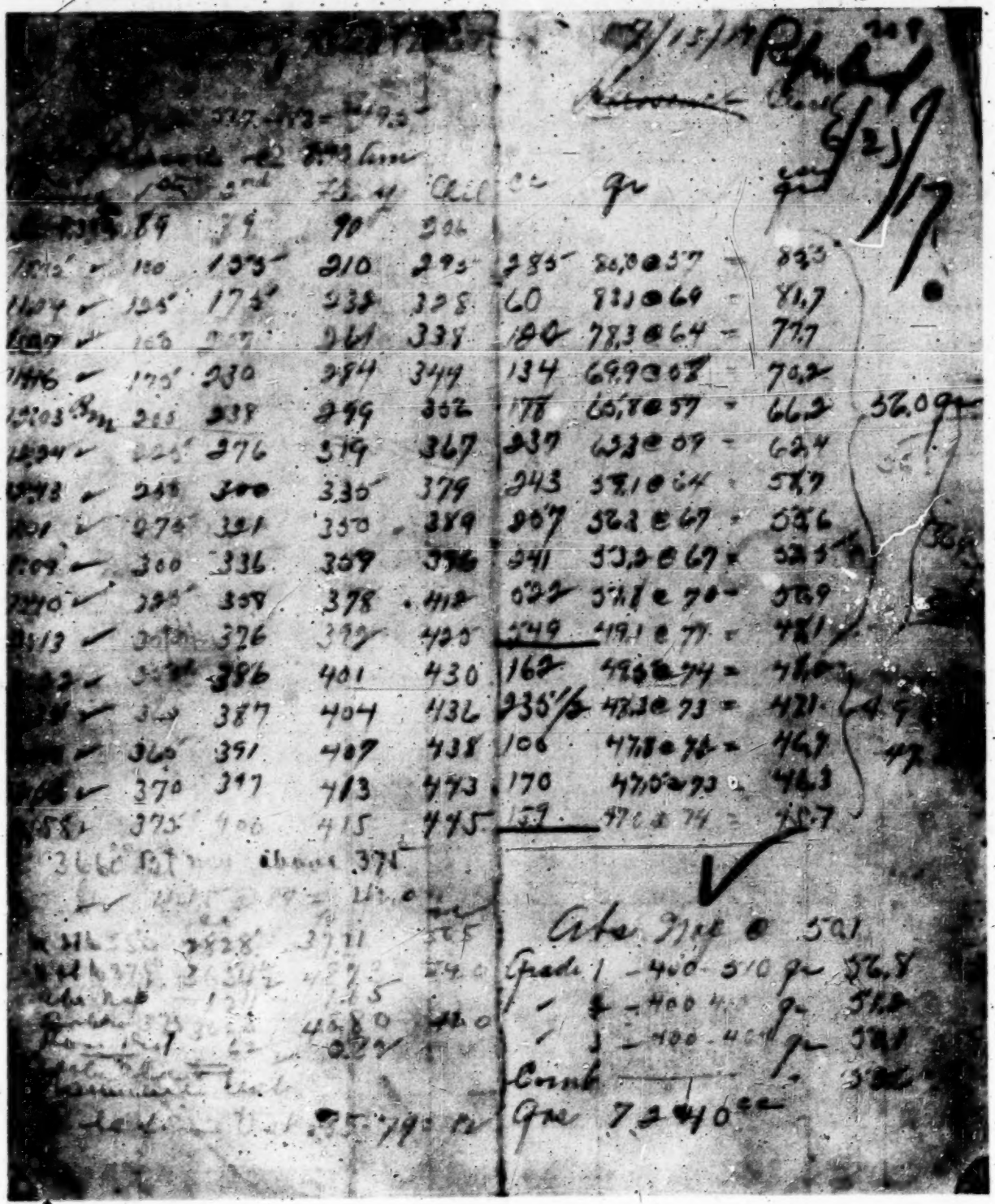
750 cc @ 81

Gr. 53.7 @ 81 = 51.6

1245	110	162	210	264	405	70.5 @ 54	71.5
1250	170	213	266		48	82.7 @ 57	83.9
115	185	222	282		215	79.3 @ 61	78.9
153	211	246	296		255	73.2 @ 56	73.5
215	221	262	306		245	63.0 @ 60	68.0
250	256	285	328		458	63.5 62	63.3
325	281	309	350		464	60.9 70	59.8
432	314	342	374		542	57.6 71	56.4
513	338	362	394		465	53.9 72	52.7
555	362	383	410		395	53.0 74	50.6
[illegible]	383	402	425		600	49.2 73	
[illegible]	384	404	426		60	49.0 @ 87	
600	390	406	429		60	48.6 @ 86	
643	393	409	431		664	48.2 @ 86	
6[illegible]	397	414	434		104	47.9 @ 86	
703	406	421	442		200	46 @ 74	
709	410	425	446		87	46.7 @ 86	
710	388	413	427	448	46	46.3 @ 82	
776	0	416	429	450	76	46.0 @ 82	
738	395	418	440	458	250	45.6 @ 82	
744	400	430	447	460	70	44.6 @ 79	







Barrett Co. July 16th 1917. 214

10% Distillation by Coil 9

500 cc @ 85

Gr. 53.8 @ 85 = 51.4

Book 96

10% 192 - 80.7 @ 50 = 82.3
20% 232 - 69.4 @ 63 = 71.7
30% 241 - 57.4 @ 76 = 59.9
40% 328 - 53.8 @ 61 = 53.0
50% 363 - 50.2 @ 63 = 50.0
60% 398 - 46.9 @ 70 = 46.0
70% 429 - 43.7 @ 71 = 44.8
80% 462 - 41.5 @ 72 = 40.5
90% 500 - 39.9 @ 78 = 38.5
E.P. 554 - 27 cc = 81 @ 82 = 36.8

Barrett Co. July 16th 1917 215

10% Distillation by Coil 9

500 cc @ 85

Gr. 51.4 @ 85 49.1

Le 110

10% 240 - 733-54 = 74.1
20% 307 - 60.3 @ 60 60.3
30% 350 - 53.5 @ 66 = 52.9
40% 374 - 49.1 @ 64 = 48.7
50% 394 - 46.9 @ 64 = 46.5
60% 414 - 45.5 @ 64 45.1
70% 432 - 44.4 @ 64 = 44.0
80% 456 - 43.5 @ 65 = 43.1
90% 490 - 42.2 - 66 - 41.7
E.P. 592 - 37 cc = 41 @ 82 - 39.2

Barrett Co.

216

July 16th 1917.

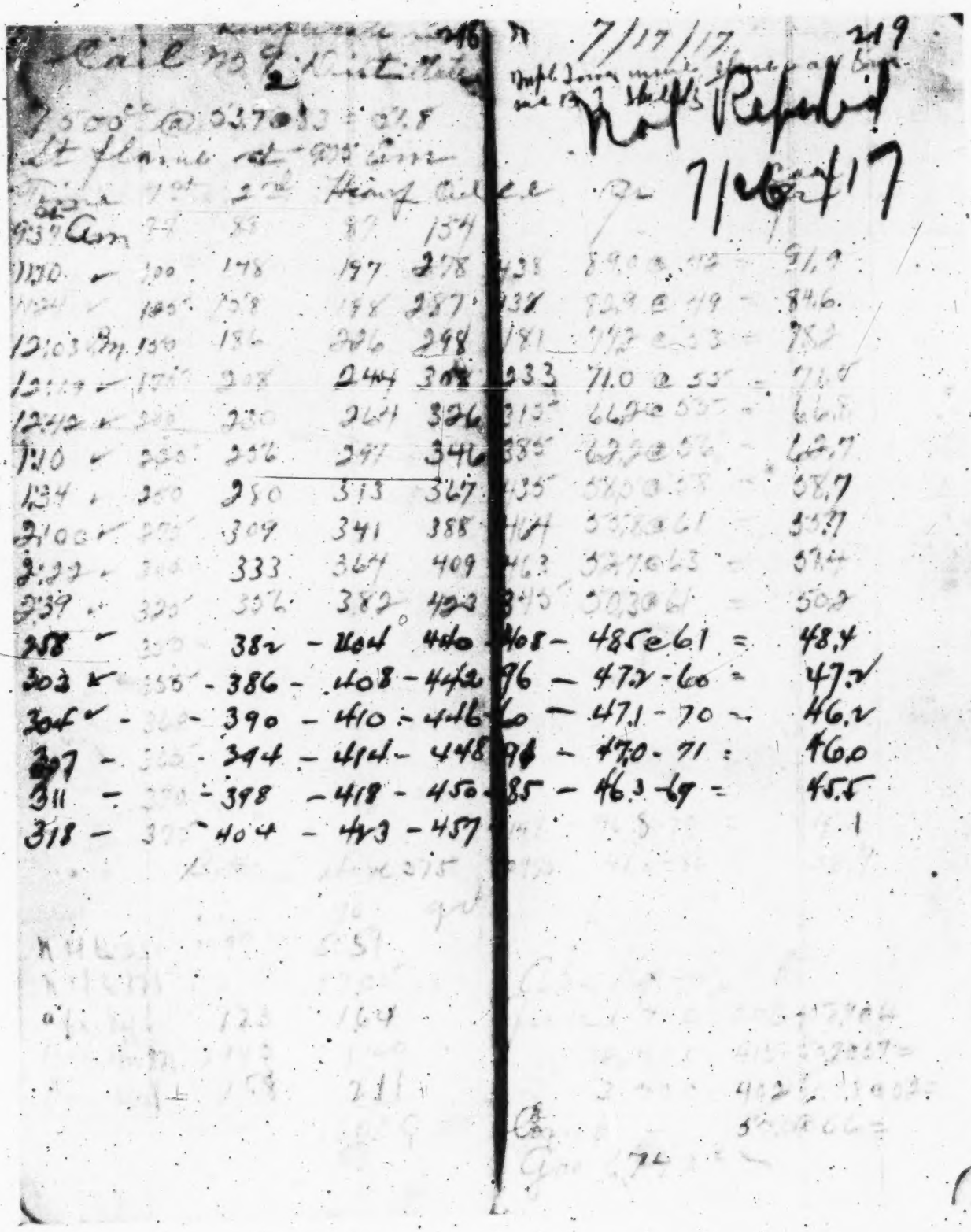
Bottoms above 375
Coal 9,
590 @ 86
Gr. 38.8
St 40 v
10% 428-419-84 = 39.9
20% 436-435-80 = 41.6
30% 443-419-76 = 40.6
40% 456-415-76 = 40.v
50% 466-408-74 = 39.3
60% 475-40-72 = 39.0
70% 486-395-72 = 38.6
80% 503-39-74 = 37.9
90% 526-377-76 = 36.5
Ch 680-365-82 = 348
Residuum 9%
Flash 180
Fire 210
Vis 40
Paraf 0
Color 190 - 1/2"

217

July 18th 1917

Bottoms above 375
Coal 10 (duplicate)

Sp gr @ 15
Gr [illegible] = 42.3
St. 380
10% [illegible] = 41.7
20% [illegible] = 41.2
30% [illegible] = 41.x
40% [illegible] = 43.5
50% [illegible] = 43.0
60% [illegible] = 41.8
70% [illegible] = 41.7
80% [illegible] = 40.1
90% [illegible] = 40.8
End [illegible] = 38.2
Residuum 7%
Flash 170
Fire 205
Vis 37
Paraf 0
Color 80 (1/2")



Ref Rebuttal
7/26/17

July 17-1917

Coil 10.

500 cc @ 54

Shot 42

Lt	380	Hot
10%	418	46.5 @ 83 = 47.8
20%	426	46.1 @ 83 = 44.1
30%	432	46.0 @ 84 = 43.1
40%	440	45.6-86 = 43.3
50%	449	46.0 @ 92 = 43.2
60%	460	46.0-90 = 42.4
70%	[illegible]	44.0 @ 86 = 41.9
80%	484	45.1 @ 82 = 41.2
90%	507	42.0 @ 82 = 40.4
100%	525	40.5 @ 84 = 38.6

(Hot.)

July 17-1917

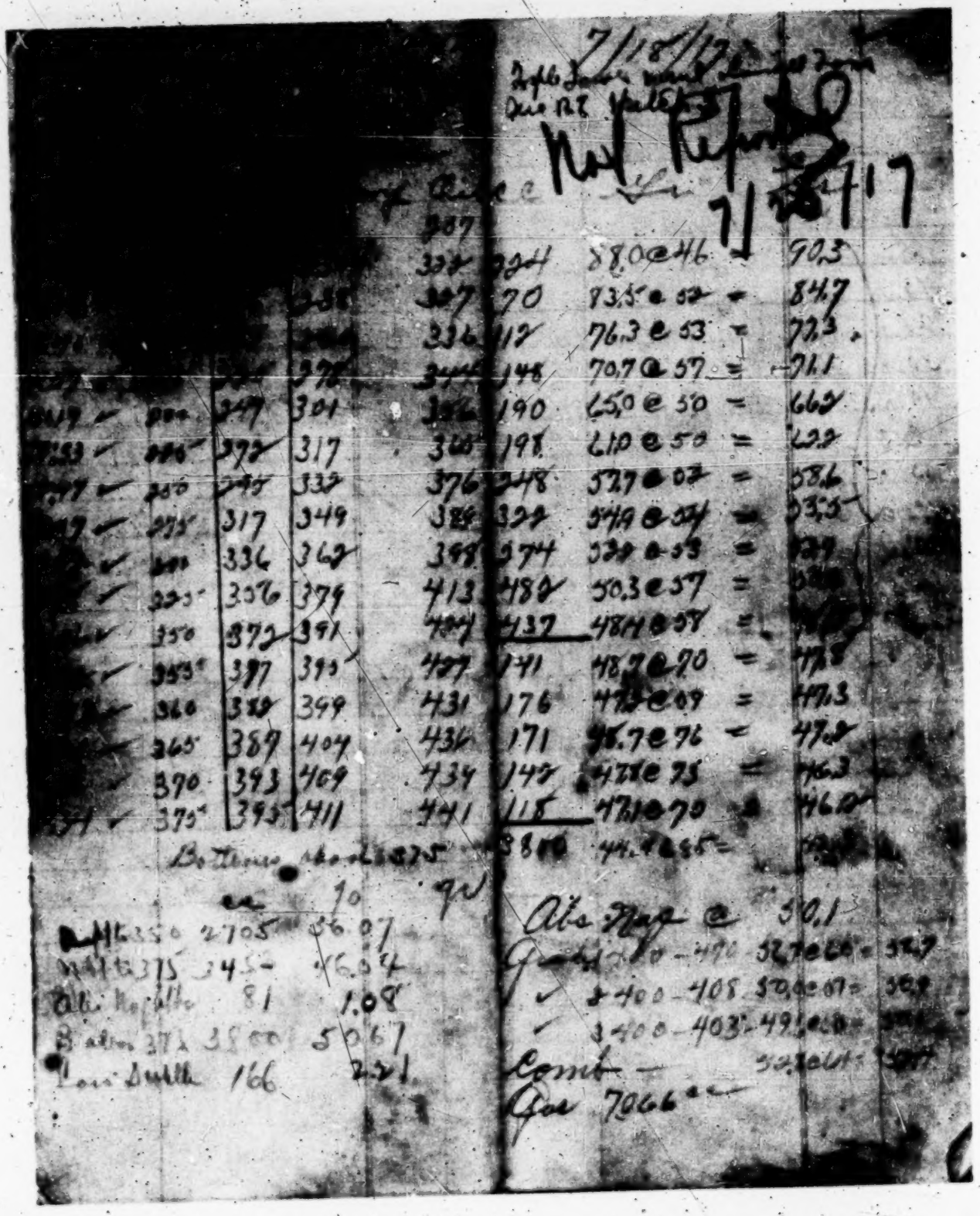
Reptile 100 @ 350 Coil 10.

500 cc @ 60

Shot 56.5

Lt	108	Temp.	Shot
10%	208	70.5 @ 48 = 72.1	
20%	229	64.5 @ 36 = 67.6	
30%	247	62.0 @ 49 = 63.4	
40%	268	59.0 @ 47 = 61.1	
50%	283	56.5 @ 49 = 57.7	
60%	297	54.1 @ 40 = 55.2	
70%	316	52.3 @ 46 = 53.7	
80%	330	51.1 @ 48 = 52.2	
90%	347	48.9 @ 51 = 49.9	
100%	375	47.4-48.2 @ 48 = 47.8	

Shot 64.22



July 18-1917

Naphtha 100-350

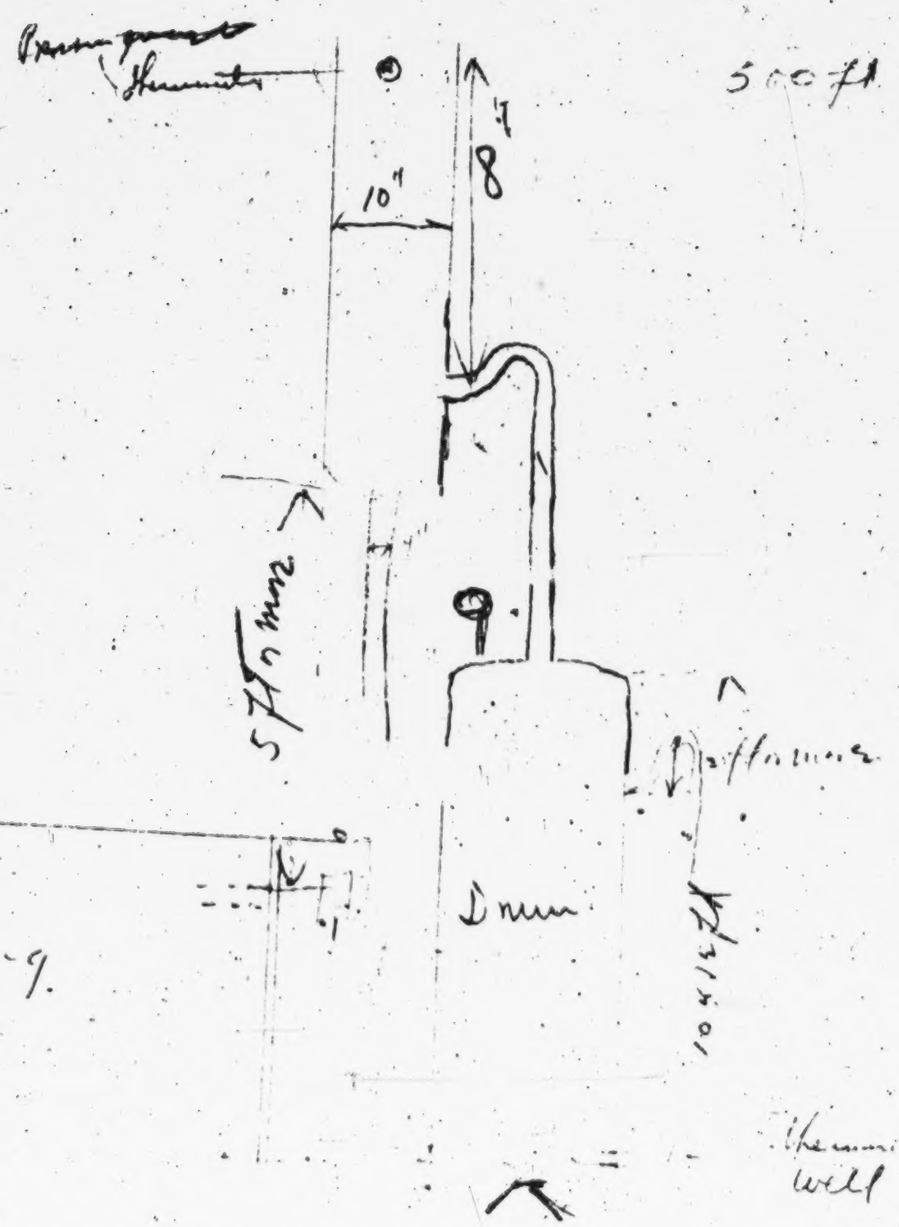
Coil 9

Sour 64.6

Gravity 57.7 @ 46 = 59.2

St	136
10%	190 - 73.4 @ 68 = 72.3
20%	207 - 69.9 @ 64 = 69.4
30%	224 - 65.5 @ 51 = 66.6
40%	238 - 62.8 @ 50 = 63.4
50%	252 - 60.0 @ 50 = 61.1
60%	265 - 58.0 @ 52 = 58.9
70%	284 - 55.6 @ 55 = 56.0
80%	299 - 54.0 @ 56 = 54.4
90%	324 - 51.8 @ 60 = 51.8
EP.	422 - 46.2 - 49.8 - 49.2
Res.	4%

225



Specification:

To stand 400 lbs working pressure

Drum to be so arranged that heat can be applied to lower half by gas burner

Outlet gauge thermometer & hand stand to steel

Draft.

Manhole to be built small

Furnace to be built more efficient than [illegible]

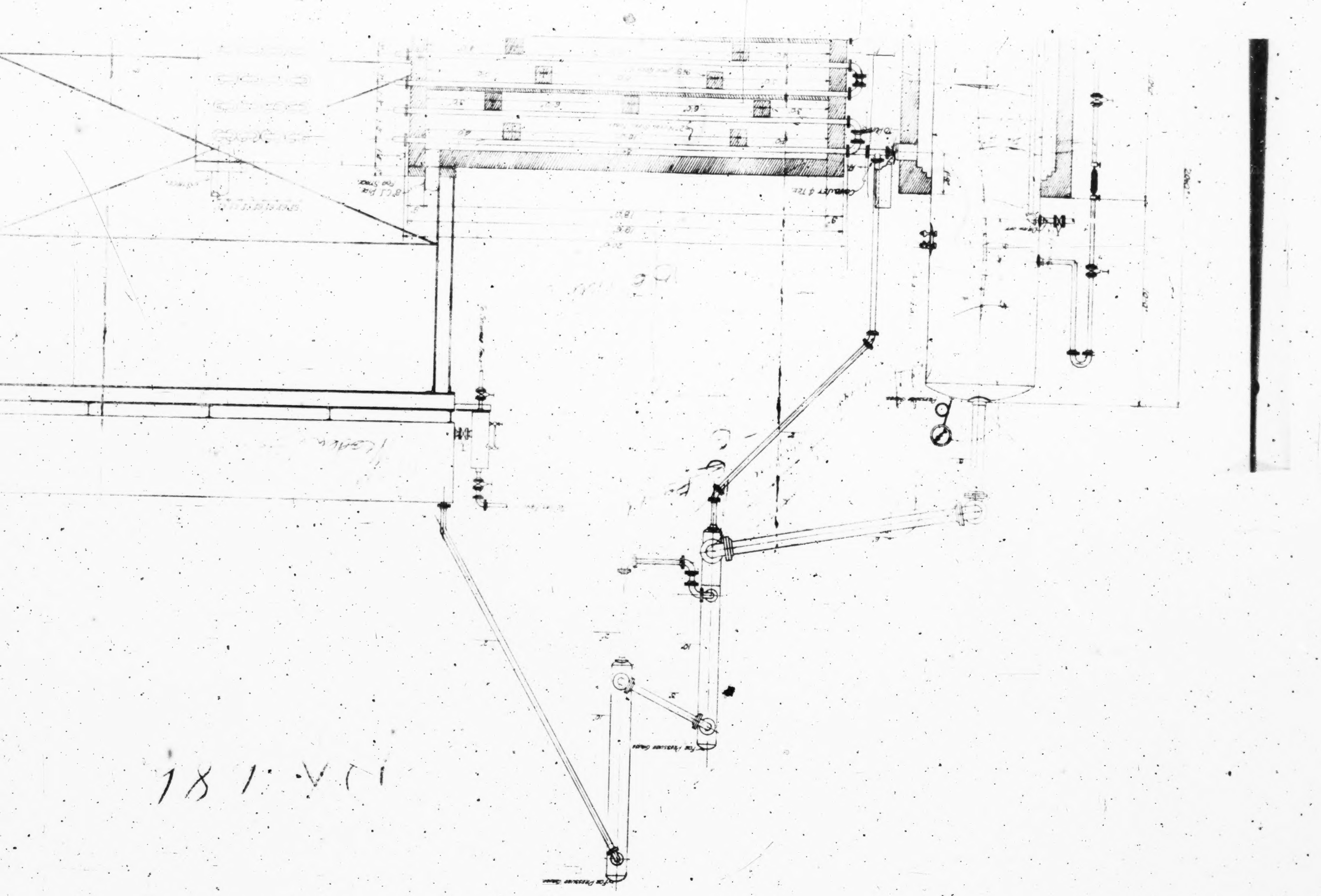
Suffish for tubes in Middle of furnace

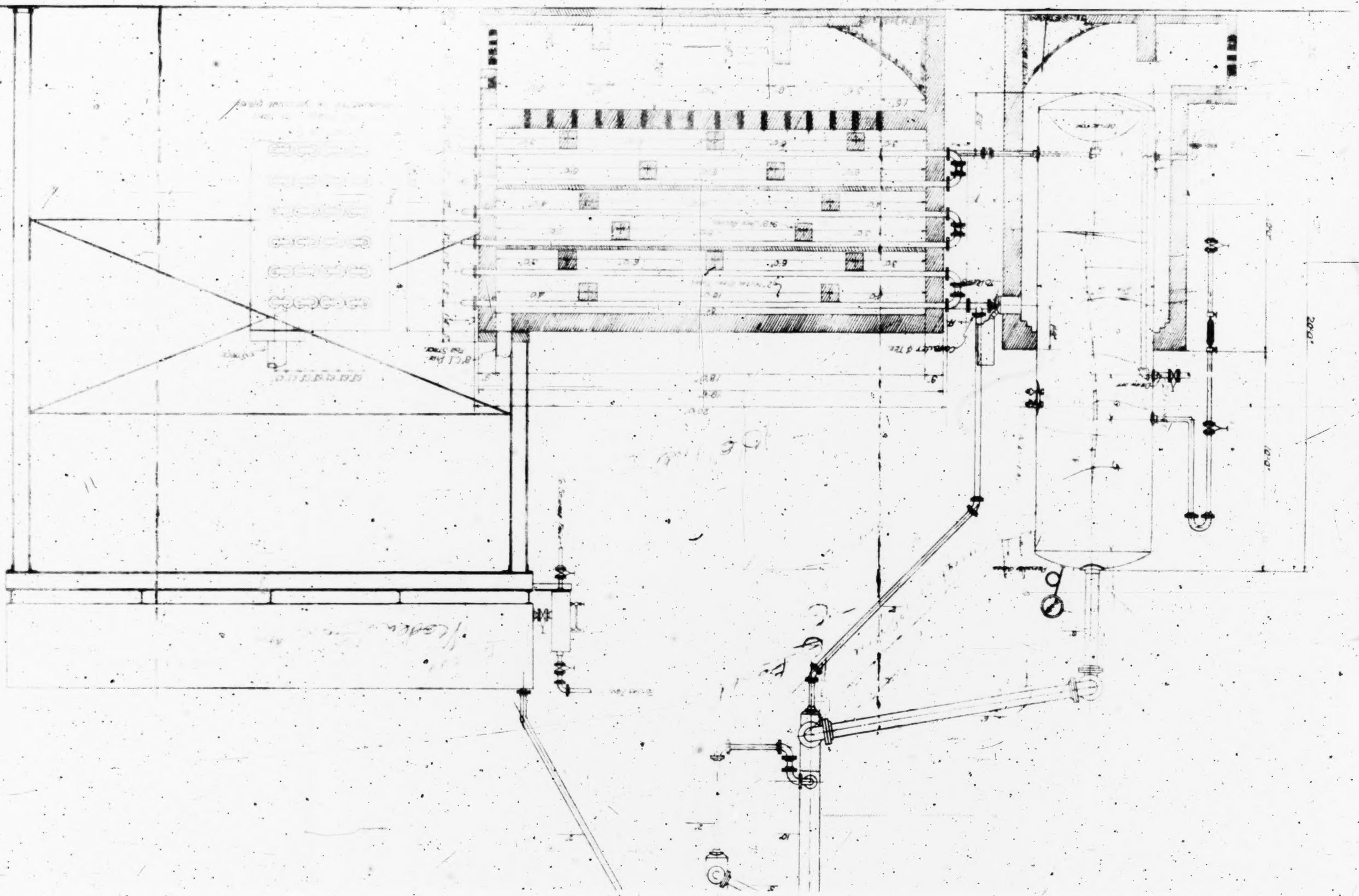
Safety Valves

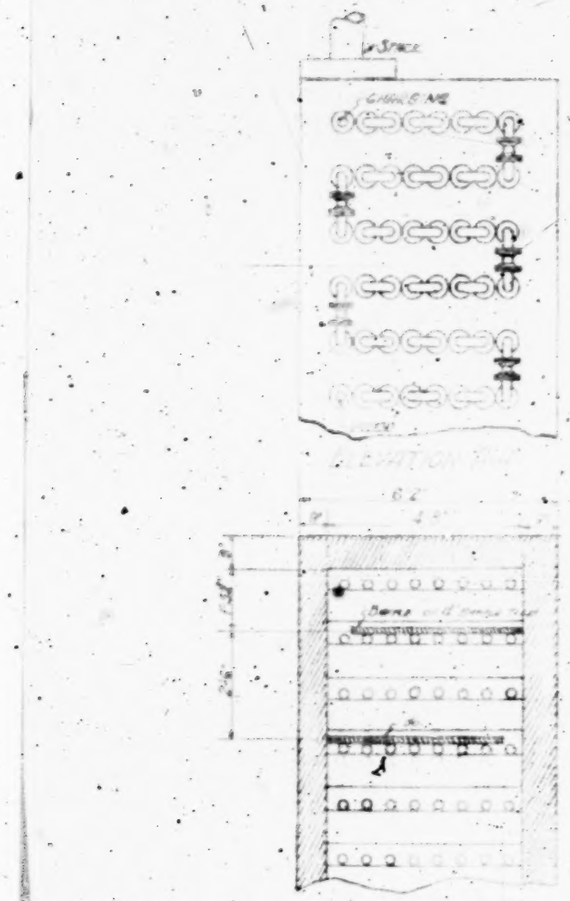
Vert Cornish Pat Lever

Horiz Cornish Pat Lever

DX 685







THE TEXAS COMPANY

REFINING DEPARTMENT
PORT ARTHUR WORKS

HIGH PRESSURE COIL STILL EXP #8

SCALE 1" = 1' 0" DATE 9-24-37 REVISED

DRAWN BY	SUPPLEMENTAL NO.	PRINT NO.
CHECKED BY	X1709	Y2200

4481 **DX 687.**

The Texas Company
Houston, Texas, November 5th, 1917.

Mr. A. S. Bailey,
Port Arthur, Texas.

Dear Sir:

Referring to your letter of October 6th, requesting that we secure quotations on a 4' x 20' High Pressure Still with all trimmings as shown by your drawing U-2212, I hand you herewith copy of quotation just received from Mr. Colling.

Awaiting your further advice, we are

Yours truly,

R. G. Dawson
Southern Purchasing Agent.

RGD-bdh

4482 (Copy)

New York City, November 1st, 1917.

Subject: Stills

Mr. R. G. Dawson,
Houston, Texas.

Dear Sir:

Replying to your letter of October 8th requesting price on one 4' x 20' high pressure still complete as per drawing 2212.

We have received quotation from the M. W. Kellogg Company, of $4678.00 for this equipment, in accordance with our drawing except as modified below, delivered f.o.b. Jersey City, N. J., approximate shipping weight 18,000 pounds.

M. W. Kellogg Company have figures on the still to have a shell 1¼" thick and heads 1⅜" thick, for a working pressure of 500 lbs. per square inch and with a factor of safety of 4. They have also substituted in place of the 6" tapped flange shown in the center of one head a 16" flanged nozzle, in order to have an opening there large enough to permit of getting the necessary apparatus through same for making final weld in the shell. Kellogg has figured on a cast

steel flange to go on this outlet tapped for 6" pipe, and have also figured on a cast steel blind flange for the 15" manhead in the side of the still.

All welding in connection with this still will be forge and hammer welding. In the case of the 2" outlets required, they have not figured on putting on flanges as shown on your print, but have simply figured on making a 2" tap in the shell, which is sufficiently heavy to permit of this.

The above prices are based on Kellogg's ability to purchase the necessary steel at a base price of 3¼c per pound, Pittsburgh, and quotation is contingent on their being able to buy the steel at the price offered. If there is any variation about or below 3¼c per pound their quotation will be changed accordingly.

They advise necessary material could be shipped from the mill in three to four months, after receipt of our order, and the steel could be manufactured and ready for shipment within one month after receipt of the necessary material for making it.

Very truly yours,
Signed: A. F. Colling,
Manager Purchasing Department.

JEB LVD

(In margin) Mr. Behimer Pl/n & return with your thought.

4483 DX 689.

THE TEXAS COMPANY

Port Arthur, Tex., Nov. 8th, 1917

High Pressure Stills

Reference: Communication of Nov. 1st, 1917,
A. F. Colling to R. G. Dawson

Mr. Otto Behimer,
Building.

Dear Sir:

I have your letter of Nov. 7th under the above subject and in reply would state that I believe the Kellog proposition for a still of this type merits our serious consideration. Their price of $4,678.00 f. o. b. New Jersey, while

appearing high, looks to be in line when it is considered that they have guaranteed this still for a working pressure of 500 lbs. with a factor of safety of 4. We have checked up weights of iron for the shell and the head, and find they are ample, and, since they seem to be very confident that the still they manufacture will meet our requirements, I believe we are warranted in going ahead with the rest of the design for this apparatus, and I would be glad to get together with you and other parties interested at an early date.

I would be glad to have Mr. Manley, who is receiving copy of this letter, to indicate his thought in regard to the installation of this apparatus at the present time.

From the best information I have at present, it seems that this whole unit complete and ready to run, will cost approximately $13,000.00.

Yours truly,
A. S. Bailey.

ASB-LJ
FTM-FPD

4484 DX 691.

THE TEXAS COMPANY

Port Arthur, Tex., Dec. 14th, 1917.

Mr. R. G. Dawson,
Houston, Texas.

Dear Sir:

We have developed a need for special flanges, elbows and return bends, for 2 in. pipe to withstand a working pressure of 500 lbs. per sq. in. at a temperature of 800 degrees Fahr.

It is preferred that the bolts in these flanges be spaced in the open if practical; that is, to space them so that none will be directly under the bend, as it is our intention to connect a series of rows of pipe together, and for repairing, desire an accessible connection.

We are desirous of any recommendations proposed by any of the pipe manufacturers, with a full description of the joint, accessibility, kind of material, location, and number of bolts used in the fittings they are able to fur-

nish, together with a price in lots of 50, stating time required for delivery.

We will appreciate your earnest endeavor to develop this matter.

Yours truly,
A. S. Bailey.

RCK-LJ

4485 DX 692.

THE TEXAS COMPANY
Houston, Texas, January 3rd, 1917.

Pipe—Fittings.

Mr. A. S. Bailey,
Port Arthur, Texas.

Dear Sir:

A letter on the above subject, addressed to Mr. R. G. Dawson, dated December 14th, dictated by R. C. K. of your department and signed by yourself, has been referred to us for notation.

We beg to state that the question of fittings required for 500# pressure at a temperature of 800° F. is one that has been worrying us for sometime, and we do not seem to be able to do better than having cast steel fittings offered for this service. It appears to us that the forged steel screw fittings, as outlined on pages #362, 363 and 699 of Crane's Catalog #50 are best adapted for working pressure and temperature above noted, although their safe working pressure is far in excess of our requirements. We have had from time to time conversations with salesmen of the various pipe and fittings concerns, and have sounded them as to the probability of special grade of iron being used where fittings are to be used in connection with high temperature distillation, but apparently this question has not been debated by any of the manufacturers as yet, nor are we acquainted with the practice of other concerns who are using high pressure distillation processes which may or may not require a special grade of cast iron or steel fittings in connection with their pipe work.

In connection with the Five Vertical Stills, which are being installed under Estimate #2025, it was our original intention to use Crane Extra-heavy Cast Iron Fittings for

a working pressure, which originally was not to have exceeded 125# per square inch, and temperature of 700° F. Quite recently it was decided to increase working pressure to 200# per square inch; this pressure being limited to
the safe working pressure of the stills themselves.
4486 In this connection, Mr. R. C. Holmes advised that
all fittings directly in contact with the most extreme heat, such as elbows on vapor lines, charging lines, regulating lines, etc., should be of cast steel. These fittings, under ordinary conditions, you are aware are good for safe working pressure up to 1200# per square inch, or more according to their size. With fittings of this type, we feel reasonably sure that no amount of stress due to shrinkage or expansion of lines will cause them to break, as certainly the internal pressure will not be in anyway near enough to even bring them anywhere near their bursting limit. This leaves the only unknown factor—that of the effect of extreme high temperature on the texture of the material combined with high internal pressure.

As we have said before, we have not been able to get any information along this line from any of the manufacturers furnishing us with fittings, and it looks as though we are left to experiment with the various kinds of fittings of standard manufacture and select from them such fittings as we find best to serve our purpose. Of course, on small installations the question of economy would be negligible, but should any of the high pressure processes, now being used or experimented with, prove to be economical as well as adaptable, no doubt large installations would be contemplated at our various refineries, in which case it would appear that the question of economy would be one to be considered. In this connection, it is entirely possible that a grade of fittings could be found which would be satisfactory and considerably less expensive than either
4487 cast or forged steel.

In this connection, we beg to state that we have just received a quotation on a comparatively small quantity of cast steel fittings for use in the installation of the Five Vertical Stills on the Westside, which amounts to approximately $3,800.00; but in order to be absolutely sure that every precaution has been taken to avoid bursting of fittings, we were compelled to purchase at this price.

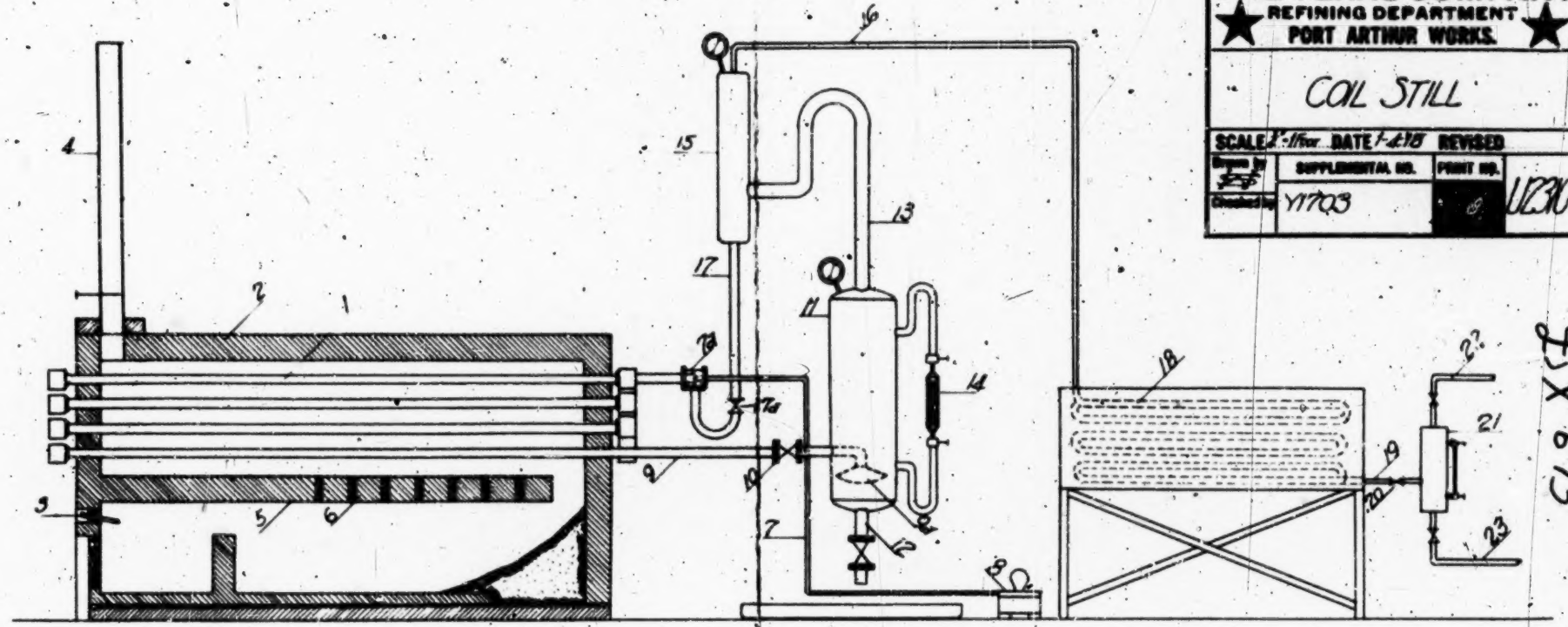
Should you in the future develop any information, through personal conversation or otherwise, relative to

high pressure type temperature fittings, we will be glad to have you furnish us with information regarding same, as we have about given up this question and decided on using the best grade of fittings procurable on any future installations of this kind which may be contemplated.

Yours very truly,

F. P. Risdon.

FPR-EFG
FTM.


THE TEXAS COMPANY
REFINING DEPARTMENT
PORT ARTHUR WORKS.
COIL STILL
SCALE 1"=1'-0" DATE 1-4-18 REVISED
SUPPLEMENTAL NO.
PRINT NO.
Y1703
U230
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DX 695

2651

4490 DX 696.

390

DEPARTMENT OF COMMERCE

United States Patent Office

To all persons to whom these presents shall come, Greeting:

This Is to Certify that the annexed is a true copy from the records of this office of the Petition, Specification, Oaths and Drawing, as originally filed, November 21, 1918, Serial Number 263,552, in the matter of the

Letters Patent of

Otto Behimer, assignor,
by mesne assignments, to
The Texas Company,

Number 2,027,014, Granted January 7, 1936,

for

Improvement in Processes for Making Gasoline.

In Testimony Whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed, at the City of Washington, this sixteenth day of October, in the year of our Lord one thousand nine hundred and thirty-seven and of the Independence of the United States of America the one hundred and sixty-second.

Conway P. Coe,
Commissioner of Patents.

(Seal)

Attest:

C. W. Sutton,
Acting Chief of Division.

4491 PETITION.

(Stamp) U. S. Patent $15 Rec'd a Nov 21 1918 C. C. U. S. Pat. Office.

To the Commissioner of Patents:

Your Petitioners Ralph C. Holmes, Frederick T. Manley, & Otto Behimer, residing respectively, at New York, in the County of New York and State of New York; Houston, in the County of Harris, and State of Texas; Port Arthur, in the County of Jefferson, and State of Texas, and whose P. O. Address is ..... pray that Letters Patent of the United States may be granted to them for the Improvement in Process and Apparatus for Making Gasoline set forth in the annexed specification; and they hereby appoint the firm of Foster, Freeman, Watson & Coit, consisting of Charles E. Foster, James A. Watson, and John M. Coit (Registration No. 51), of the City of Washington, District of Columbia, their Attorneys, with full power of substitution and revocation, to prosecute this application; to make alterations and amendments therein; to receive the patent, and to transact all business in the Patent Office, and before the Courts, D. C., connected with the application or with the patent granted thereupon, and to do all other lawful acts and things which they if personally present could.

(Inventor sign full name here.)
Ralph C. Holmes.
Frederick T. Manley.
Otto Behimer.

Revenue Stamp.

SPECIFICATION.

To whom it may Concern:

Be it known that we, Ralph C. Holmes, Frederick T. Manley and Otto Behimer, citizens of the United States and residing respectively, at New York, in the County of New York and State of New York; Houston, in the County of Harris, and State of Texas; Port Arthur, in the County of Jefferson, and State of Texas, have invented certain new and useful improvements in Process and Apparatus for

Making Gasoline, of which the following is a specification:

4492 This invention relates to methods and apparatus for making condensable light oils, such as gasoline.

More particularly it relates to certain novel improvements in the cracking of hydrocarbons whereby higher boiling hydrocarbons are decomposed into those of lower boiling point.

In prior methods of cracking hydrocarbon oils, considerable difficulty has been experienced on account of carbon formations, which occur on the sides of tubes and stills exposed to the heat required to carry on the cracking operation. It is a novel feature of the herein disclosed process, that the cracking operation occurs in a vessel to which no external heat is applied, except at times that are necessary to overcome heat radiation, the oil prior to its introduction to such vessel having been subjected to a high degree of heat and the excess heat of the oil itself being used to effect its own decomposition. As a consequence, we avoid carbon formations of the destructive character which have proved such an impediment to prior systems. The removal of the cracking operation from the

—2—

4493 heating zone also reduces the danger from fires such as frequently occur where cracking is carried on in highly heated stills and coils exposed to direct heat.

Our process embodies a novel circulatory system in which a ring of oil is constantly maintained under varying liquid and vapor phases. The oil to be treated on entering this ring is subjected to a high degree of heat, but the time element is so controlled that there is comparatively little decomposition while it is exposed to this external heat, the oil being rapidly removed from the heating zone and conducted to the cracking zone, where without being subjected to additional heat, it undergoes a molecular decom-

position whereby carbon and light products are formed. The
bulk of the carbon is removed from the ring by withdrawing from the cracking zone portions of the residual oil. The light products continue the cycle, leaving the cracking zone in the form of vapor and gas. These vapors and gases are then subjected to a reduction in temperature, whereby the heavier constituents thereof such as kerosene, are condensed.
The condensate is combined with the charge of oil entering the heating zone thus completing the cycle. The constituents
of the desired volatility are removed from the ring and condensed. The outlets from the ring are so controlled that the entire system is maintained under a pressure sufficient to insure the desired molecular transformation.

Our process is to be distinguished from those
of the prior art, in which a ring of liquid residuum is kept in circulation. When such oil is kept in circulation, considerable quantities of carbon are formed, owing to the readiness with which this type of oil carbonizes when exposed to

—3—

4494 high temperatures, the carbon forming in fine particles in
the oil, and wherever it comes in contact with heated metal surfaces, it attaches itself thereto and builds up deposits, which often cause the choking of tubes and coils. It also crystalizes the metal surfaces, thereby decreasing the tensile strength of the metal and causing the bulging and breaking of such surfaces. Any residual oil resulting from the cracking operation will necessarily contain a considerable amount of carbon held in suspension in the oil and to circulate such a residue through heated tubes is to continually pass into such tubes a large amount of free carbon. In our system we do not circulate a residuum, but instead keep the residual oil removed from the application of external heat and withdraw the heavier portions thereof (which contain the bulk of the carbon) from the cycle at the cracking zone, and continue the cycle by means of the vapor generated,
which contains the condensable product desired and also certain
heavier constituents which are used to complete the cycle. By

removing the heavier residuum from the cycle, we keep the ring
free from this source of carbon formation, and since we conduct the actual cracking in a vessel unexposed to external heat, we are thus able to effectively remove the carbon formed.

In cracking oil for gasoline, there is generally formed a considerable quantity of vapors heavier than gasoline, which may be generally designated by the term, kerosene:
We employ these heavier vapors as a carrier for the lighter vapors; they assist in maintaining a current of vapor by which
the gasoline is removed from the cracking zone to a separator
where the kerosene vapors are condensed and removed from the
gasoline vapors which pass on to the condenser. The kerosene condensate preferably at a tempera-

—4—

4495 ture not materially below its boiling point, is injected into
the oil charge entering the heating tubes, whereby a foamy mixture is produced, which accelerates the circulation in the heating tubes thereby preventing the oil from being overheated, and also keeping the tubes swept free from any carbon
formations. These kerosene constituents are an excellent mechanical conductor of heat, and there is thus produced a heat cycle which maintains the proper temperature in the cracking zone. By maintaining these bodies in constant circulation, the kerosene constituents, which under existing methods have been found so difficult to decompose into lighter products, are, in our system, ultimately reduced to gasoline.

We have devised certain novel apparatus which
is adapted for carrying out our process, and illustrate the preferred form thereof in the drawing which represents a diagrammatic, vertical plan view of said apparatus. It is under-

stood that other apparatus besides that illustrated may be used in carrying out our process.

The coil 1 is located in the furnace 2, having the burner 3 and the stack 4. A checkered brick baffle 5 having the openings 6 may serve to distribute the heat evenly over the coil. The charging line 7, having the jet 7^a, extends to the pump 8, which is connected to a suitable source of oil supply not shown. The pipe 9, having the valve 10, extends from the heating coil 1 to the cracking drum 11, within which it terminates in the distributor 9^a. The cracking drum is preferably heavily insulated against heat radiation and is equipped with the valved draw-off 12, and the vapor outlet 13. It may also have an oil gauge 14. The vapor outlet 13 extends to the separator 15, having the vapor outlet 16, and the con-

—5—

4496 densate outlet 17. The vapor line 16 terminates in the water-cooled condenser coil 18, having the outlet 19 equipped with the valve 20. If desired the valve 20 may be placed in the vapor line 16. The outlet 19 terminates in the collecting drum 21, having the valved gas outlet 22 and the valved condensate outlet 23. The condensate line 17, which is preferably insulated, is equipped with a valve 17^a and is connected to the charging line 7 at the jet 7^a.

In conducting the process with the apparatus illustrated, the oil to be treated is forced through the charging line 7 under considerable pressure, and is rapidly circulated through the heating coil 1, where it is heated to the desired temperature. This temperature is higher than the temperatures at which it is desired to conduct the cracking operation. The oil on being circulated through the coil acquires considerable heat, but on account of the rapidity of its flow, decomposition is only in the insipient stages, the oil being withdrawn into the outlet 9 as cracking develops and is passed into the cracking drum 11 where a constant body of oil is maintained at a cracking temperature. The distributor 9^a serves to discharge the oil into the cracking drum in a wide stream, thus spreading out the vapors and gases in the stream whereby their heat is diffused

throughout the body of oil in the drum. This heat diffusion is materially aided by using a distributor with serrated edges. The rapid circulation of the oil having been suddenly suspended, and the oil having entered a chamber

—6—

4497 of ample volume, the excess heat of the oil operates to maintain the body of oil at the desired cracking temperature and molecular decomposition is carried on vigorously, the higher boiling hydrocarbons continually breaking up into hydrocarbons of lower boiling point. The vapors and gas generated gather in the upper part of the cracking drum and pass out through the vapor outlet 13 to the separator 15, where there is effected a separation of hydrocarbon of desired volatility from those of less volatility than desired. The hydrocarbons of the desired volatility pass out through the vapor line 16, by which they are conducted to the condenser 18, where they are condensed and the condensate is either intermittently or continuously allowed to run into the collecting drum 21.

The temperature in the air condenser 15 is such that the less volatile hydrocarbons are condensed and dropped into the conduit 17, by which they are conducted to the jet in the charging line. The separator is preferably somewhat elevated so as to give a considerable head of liquid in the pipe 17, which preferably contains a U bend as illustrated in order to form a liquid seal therein. This head of liquid, together with the high pressure at which the oil in the charging line passes the jet, this pressure being ordinarily from 50 to 100 pounds higher than the pressure in the drum, insures that the condensate shall be constantly drawn into the charging line and forced into the coil 1. The introduction of this condensate into the charging line increases the volume of oil in the heating coil thereby accelerating the flow therein so that the coil is swept free from any carbon formations. This condensate consists in a type of hydrocarbons which when decomposed does

—7—

4498 not yield any great amount of carbon so that the oil charge is constantly being diluted with oil capable of being de-

composed into lighter products without the production of large amounts of carbon. This condensate reaches the jet in a heated condition, preferably at a temperature not materially below its boiling point, so as to heat the charge of oil entering the heating coil. The heat cycle formed by the kerosene constituents enables the maintenance of the proper cracking temperatures in the cracking drum. By injecting this condensate into the heating coil we increase the volume of oil flowing therein without increasing the total amount of oil in the system at any given time.

A considerable pressure is maintained throughout the system, which pressure is regulated by means of the valve 20 or the valve on the gas outlet 22. The pressure used varies with the character of the oil operated on and on the character of the product desired. Ordinarily the decomposition in the cracking drum is carried on under a pressure of from 100 to 400 pounds.

The oil to be decomposed is constantly forced into the heating coil thereby causing a steady stream of heated oil to enter the cracking chamber. The residuum is withdrawn preferably at such a rate that there is maintained a constant body of oil in the cracking zone.

It is desirable to equip the apparatus with the valves 10 and 17ª so that in case there is a break in the heating coil the effect of any fire resulting may be localized by closing said valves whereby the bulk of oil in the system will be retained in the cracking drum 11. It is understood that in the normal operation of the process these valves are open.

It is sometimes necessary to apply an auxiliary heat to the cracking drum. A convenient method of providing

4499 this auxiliary heat is to insulate only the upper part of the drum and enclose the lower portion in a furnace. In the early stages of a run, since there is no danger of overheating a carbon-free surface, the drum may be heated freely until the necessary heat cycle has been generated and decomposition has begun. But when decomposition begins, with a consequent deposition of carbon, the fire must be reduced as

otherwise the carbon would accumulate on the hot surfaces and build up tenacious formations thereon, thus preventing the effectual removal of the carbon and asphaltic bodies. As the run continues only a moderate heat is applied, sufficient only to offset the loss of heat due to radiation. If desired the drum may be heated by means of waste heat.

The product obtained by the herein disclosed process is, for a cracked product, remarkably sweet, in other words, low in unsaturated compounds.

It is understood that we use the terms "Gasoline" and "Kerosene" in this application in a somewhat broader sense than they are ordinarily used in the art. By the term "Gasoline" as used herein, we mean the volatile product desired which under the temperatures and pressures used is a vapor in the separator 15 and is condensable in the cooling coil 18. We designate by the term "kerosene" those constituents which under the temperatures and pressures used enter the vapor line 13 in the form of vapor and are condensable in the separator 15. It is to be noted that the character of the constituents which we have found convenient herein to refer to as kerosene may some-

—9—

4500 times comprise such products as are commonly known in the art as spirits or turpentine substitute.

—10—

4501 Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:

1. The process of converting a higher-boiling hydrocarbon oil into lower-boiling hydrocarbons which consists in rapidly forcing said higher boiling oil through a heated area of limited extent whereby the oil absorbs considerable heat and then passing the heated oil into a chamber under pressure and allowing the heat in the oil to effect its decomposition.

2. The process of converting hydrocarbon oil by continuously injecting same into a hydrocarbon ring, maintained under pressure, which consists in circulating

the oil through a heated coil whereby it acquires considerable heat but is removed therefrom before any material decomposition sets in, passing said oil into a body of oil maintained at a cracking temperature by the continual entrance therein of the stream of oil from the heated coil, removing from the cracking zone the residuum and vapors formed, separating the less volatile constituents of the latter and intermingling them with the stream of oil entering the heated coil, withdrawing from the ring and condensing the gasoline formed.

3. In the cracking of hydrocarbon oil, the step of removing the oil from the heating zone and allowing the heat contained in the oil to effect its decomposition.

4. In a system of converting hydrocarbons in which a body of oil is maintained under a pressure and temperature sufficient for cracking, the method of maintaining a kerosene heat cycle which consists in passing a stream of oil through a heated area thus raising it to a cracking temperature, passing it at that temperature into a body of oil, maintaining in said body of oil substantially the cracking temperature imported in said heated area for a sufficient period of time to permit the cracking operation to take place, removing from said body of oil the generated vapors, separating the kerosene therefrom, and mingling said kerosene with the stream of oil passing through said heated area.

5. The method of cracking hydrocarbons in which a body of oil is constantly maintained under pressure and at a cracking temperature, the necessary heat for decomposition being supplied thereto by a stream of heated oil entering said body of oil.

6. The continuous method of converting hydrocarbons which consists in forcing hydrocarbon oil under pressure into a heated coil and regulating the flow therein so that it absorbs considerable heat, removing said oil from the coil before any material decomposition sets in and conducting it to a vessel maintained under pressure and unsubjected to external heat where cracking is carried on by means of the heat contained in the oil, removing from the cracking zone

the residuum and vapors formed, separating the less volatile constituents of the latter and injecting them into the oil entering the heating coil.

7. The process of converting hydrocarbon oil which consists in continuously forcing said oil through a heated coil at a rate of flow sufficient to prevent decomposition of any material amount of carbon, continuously removing said oil from the coil before extensive cracking takes place and introducing it into a body of oil while in its heated condition, maintaining said body of oil at a temperature sufficent for decomposition without the application of other external heat thereto, removing the residuum and vapors formed, separating the heavier vapors from the others and continuously injecting them into the heating coil, while maintaining a pressure of upward of 100 pounds throughout the system.

8. In the cracking of hydrocarbon oils, the step of removing carbon which comprises introducing a stream of heated oil into an enlarged vessel, maintaining the temperature of the body of oil in said vessel without applying other heat, allowing the carbon and asphaltic bodies to accumulate in the bottom of said vessel and drawing off said carbon and asphaltic bodies.

9. The process of converting hydrocarbon oil which comprises circulating said oil through a heated coil until the oil acquires a high temperature, continuously removing said oil from the coil and introducing it into a body of oil whereby said body of oil is maintained at a somewhat lower temperature thereby subjecting said body of oil to decomposition, removing from said body of oil the residual bodies and vapors formed, separating out the heavier of said vapors and continuously injecting them into the heating coil, while

maintaining a pressure of upwards of 100 pounds throughout
the system.

10. The process of converting hydrocarbon oil which consists in forcing said oil through a coil and drum while applying heat to said coil and drum and allowing the vapors generated to develop pressure until decomposition of the hydrocarbon begins, then reducing the heat applied to the
drum while securing it against substantial loss of heat through
radiation and supplying the necessary heat for decomposition
by means of the stream of oil entering from the coil, the stream
4504 entering from the coil being continuously commingled with
a hot condensate separated out from the generated vapors.

11. In an apparatus for converting hydrocarbons, a charging line, a heating coil connected to a cracking drum, vapor and residuum outlets therefrom, a separator at the termination of the vapor line, a condensate pipe leading from the separator to the charging line.

12. In an apparatus for converting hydrocarbons, a heating coil, means for admitting oil thereto, an outlet from the heating coil terminating in a distributor located within a cracking drum, vapor and residuum outlets from said
cracking drum, a separator connected to the vapor outlet, and a vapor outlet terminating in a condenser.

13. In an apparatus for cracking hydrocarbon oils, a drum substantially secured against heat radiation and heated by means of a conductor in communication with a heated coil
and adapted to eject heated oil into the drum, means for removing the vapors from the drum and means whereby the heavier
thereof are condensed and injected in a heated state into the coil.

14. In an apparatus for cracking hydrocarbon oils, a heating coil connected to a cracking drum by means of a valved conduit, vapor and residuum outlets from the drum, a separator connected to the vapor outlet, means whereby con-

densate from the separator is injected into the heating coil, and means whereby vapors from the separator are removed therefrom and condensed.

15. In an apparatus for cracking hydrocarbons, a coil subjected to furnace heat and communicating with a cracking drum, auxiliary means for heating the drum, means for securing the drum against loss of heat from radiation, vapor and residuum outlets from the drum, a separator connected to
4505 the vapor outlet and having a condensate conduit connected to the coil, means for withdrawing vapors from the separator and condensing same, means for regulating pressure in the apparatus.

16. In an apparatus for cracking hydrocarbons, a heating coil communicating with a cracking drum; means for withdrawing carbon and asphaltic bodies from the drum, a vapor line connecting the drum with a separator having vapor and condensate outlets, means in connection with the condensate outlet for injecting condensate into the heating coil, means for removing vapors from the separator and condensing them and collecting the condensate, means for regulating pressure in the apparatus.

17. In the cracking of hydrocarbon oil, the step of removing the oil from the heating zone and allowing the heat contained in the oil to effect its decomposition in a chamber unsubjected to external heat except such as may be necessary to prevent undue heat radiation.

4506 In testimony whereof we affix our signature.

Ralph C. Holmes.
Frederick T. Manley.
Otto Behimer.

Inventor Must sign first given name in full.

OATH.

County of New York }
State of New York } ss.

Frederick T. Manley, one of the above named petitioners, being sworn or affirmed, deposes and says that he is a citizen of the United States and resident of Houston, in the County of Harris and State of Texas, that he verily believes himself to be the original, first, and joint inventor of the Improvement in Process and Apparatus for Making Gasoline, described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before their joint invention or discovery thereof, or patented or described in any printed publication in any country before their invention or discovery thereof, or more than two years prior to this application, or in public use or on sale in the United States for more than two years prior to this application; that said invention has not been patented in any country foreign to the United States on an application filed by them or their legal representatives or assigns more than twelve months prior to this application; and that no application for patent on said improvement has been filed by them or their representatives or assigns in any country foreign to the United States.

Inventor's full name—
Frederick T. Manley.

Sworn to and subscribed before me, this 1st day of October, 1918.

(Seal)

Edward Crone, Jr.,
Notary Public.
(Signature of Notary.)
Notary Public
New York, Co. Clerk's No. 190
New York Co. Register's No. 10054

My Commission expires March 31, 1920.

4507 In testimony whereof we affix our signature.

Inventor Must sign first given name in full.

OATH.

County of New York } ss.
State of New York }

Ralph C. Holmes, one of the above named petitioners, being sworn or affirmed, deposes and says that he is a citizen of the United States and resident of New York, in the County of New York, and State of New York, that he verily believes himself to be the original, first, and joint inventor of the Improvement in Process and Apparatus for Making Gasoline, described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before their joint invention or discovery thereof, or patented or described in any printed publication in any country before their invention or discovery thereof, or more than two years prior to this application, or in public use or on sale in the United States for more than two years prior to this application; that said invention has not been patented in any country foreign to the United States on an application filed by them or their legal representatives or assigns more than twelve months prior to this application; and that no application for patent on said improvement has been filed by them or their representatives or assigns in any country foreign to the United States.

Inventor's full name—
Ralph C. Holmes.

Sworn to and subscribed before me, this 24th day of October, 1918.

(Seal)

Edward Crone, Jr.,
Notary Public.
(Signature of Notary.)
Notary Public
New York Co. Clerk's No. 190
New York Co. Register's No. 10054

My Commission expires March 31, 1920.

4508 In testimony whereof we affix our signature.

Inventor Must sign first given name in full.

OATH.

County of Jefferson }
State of Texas } ss.

Otto Behimer, one of the above named petitioners, being sworn or affirmed, deposes and says that he is a citizen of the United States and resident of Port Arthur, in the County of Jefferson and State of Texas, that he verily believes himself to be the original, first, and joint inventor of the Improvement in Process and Apparatus for Making Gasoline, described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before their joint invention or discovery thereof, or patented or described in any printed publication in any country before their invention or discovery thereof, or more than two years prior to this application, or in public use or on sale in the United States for more than two years prior to this application; that said invention has not been patented in any country foreign to the United States on an application filed by them or their legal representatives or assigns more than twelve months prior to this application; and that no application for patent on said improvement has been filed by them or their representatives or assigns in any country foreign to the United States.

Inventor's full name:—
Otto Behimer.

Sworn to and subscribed before me, this 31 day of Oct., 1918.

G. Stevens, Jr.,
(Signature of Notary.)
Notary Public.
Notary Public in and for Jefferson County, Texas.

(Seal)

My Commission expires June, 1919.

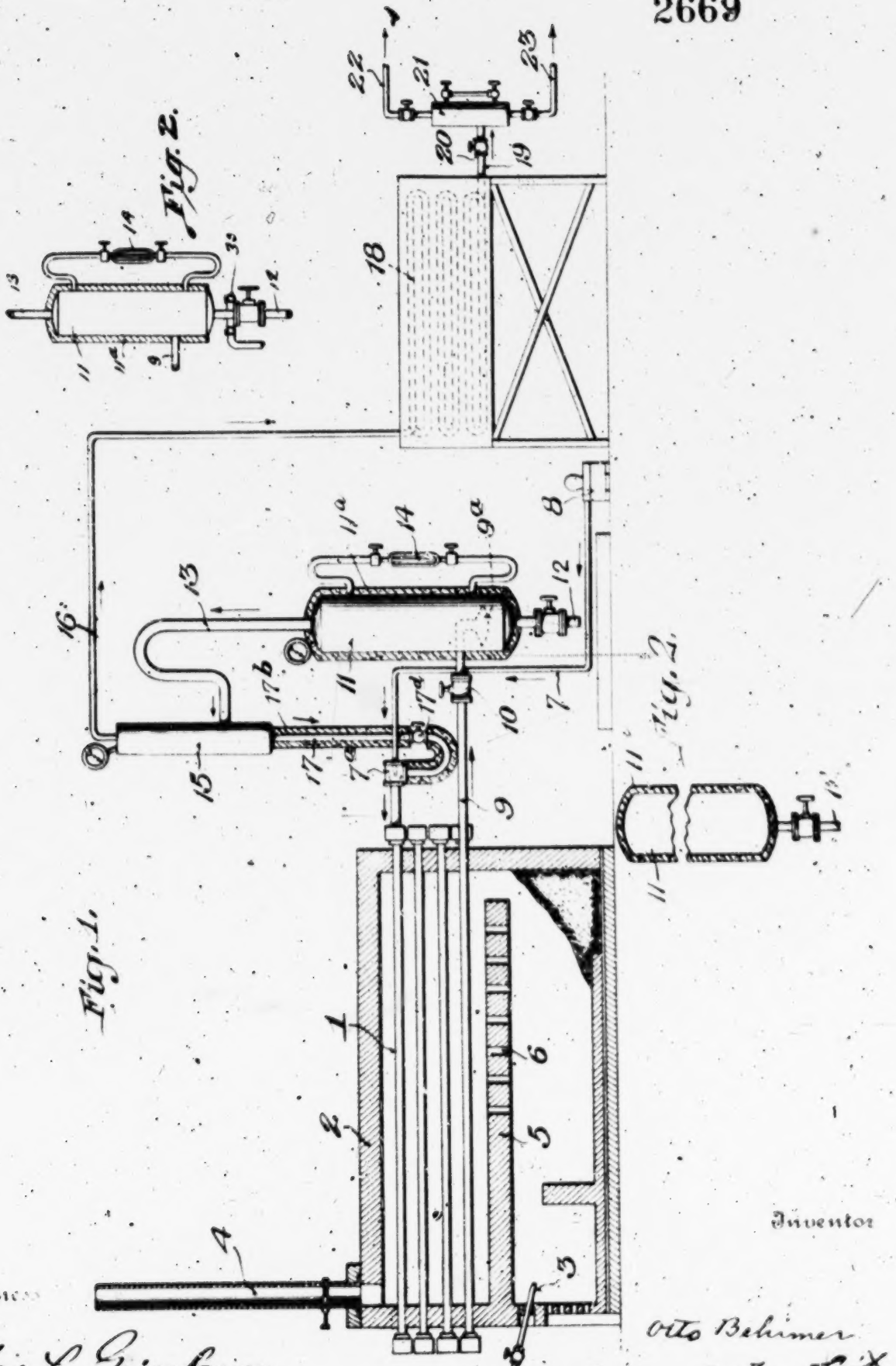
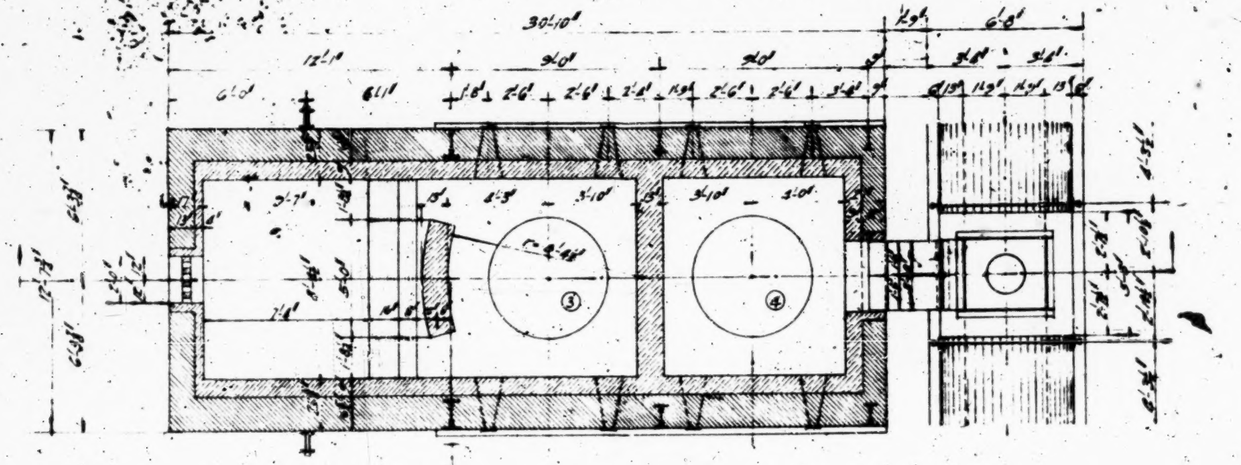


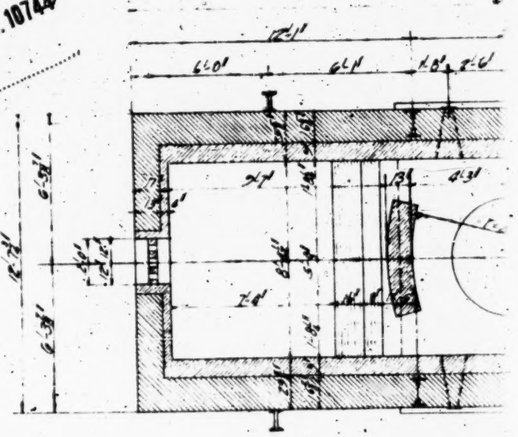
Fig. 2.
Fig. 1.
Fig. 2.
Witness
Chas. L. Griesbauer
Inventor
Otto Behimer
by Foster, Freeman, Watson & Coit
Attorneys

DX 6

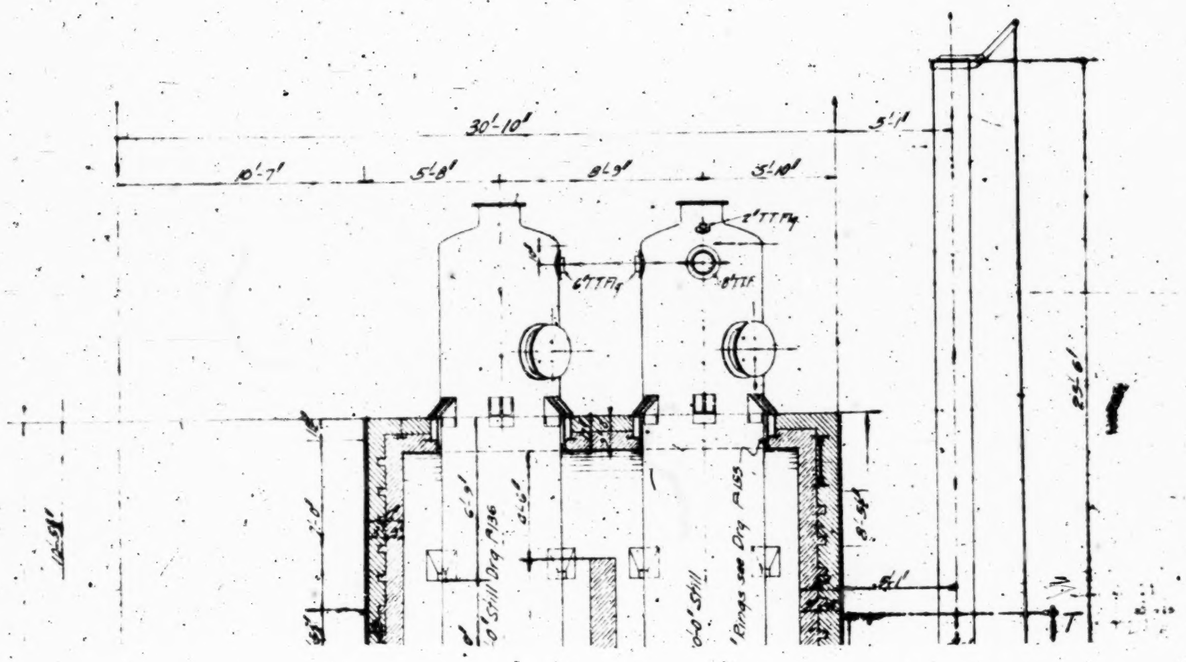
IN THE UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION
UNIVERSAL OIL PRODUCTS CO.
VS.
GLOBE OIL & REFINING CO.
No. 10744
DEFENDANT'S EXHIBIT 6

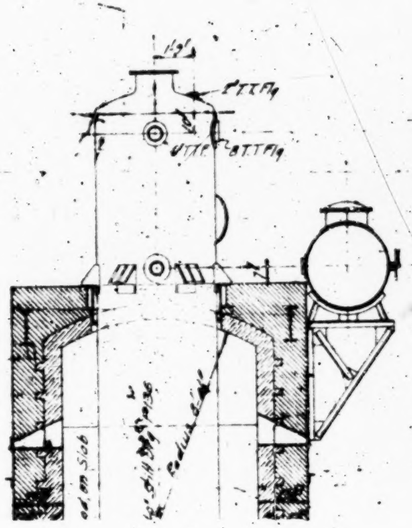


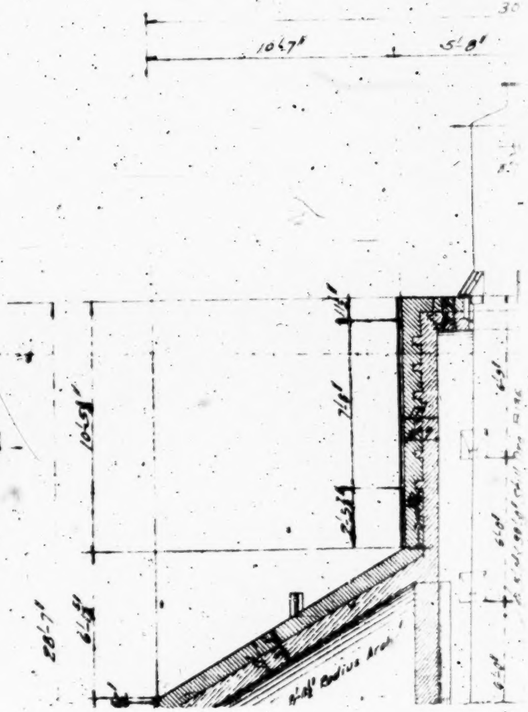
PLAN T-T BATTERY NO 2



PLAN U-U



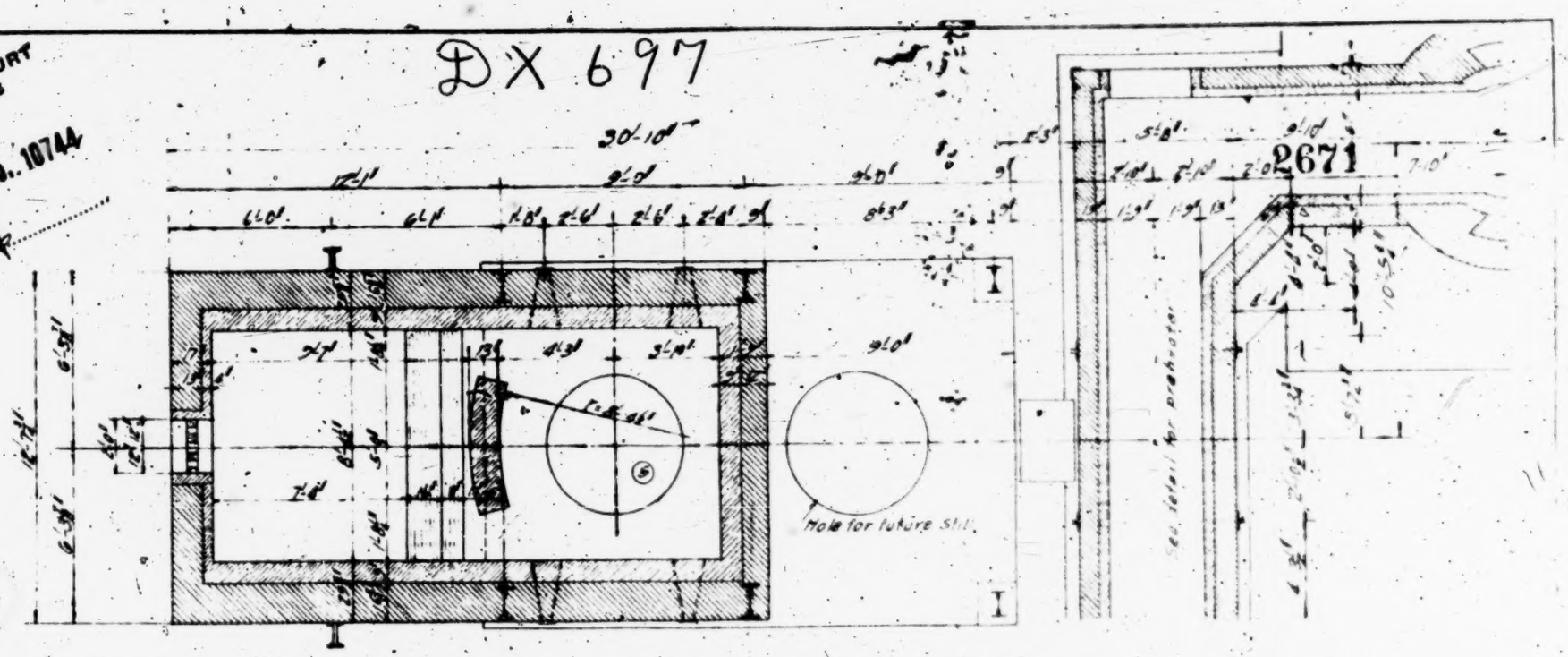




DX 697

UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION
ROYAL OIL PRODUCTS CO.
VS.
ARABE OIL & REFINING CO.
No. 10744
DEFENDANT'S EXHIBIT 697

2671



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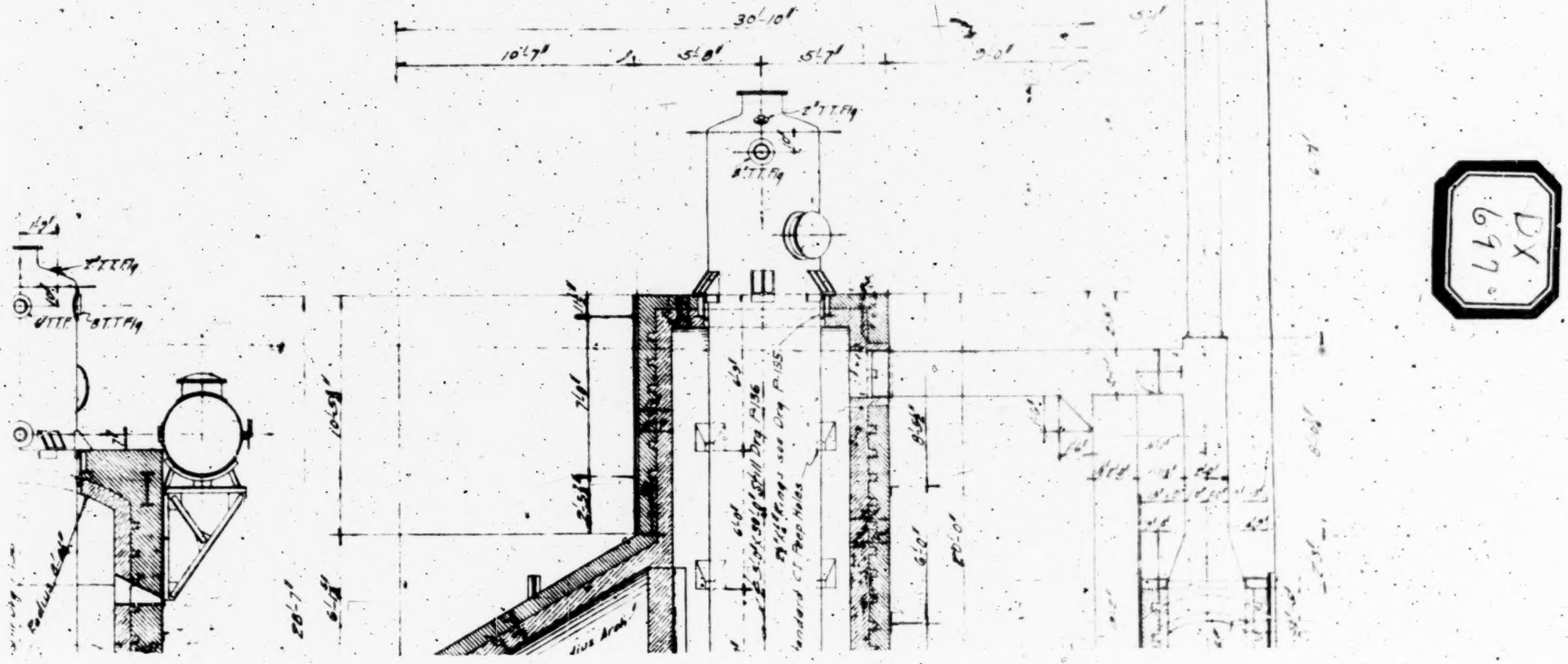
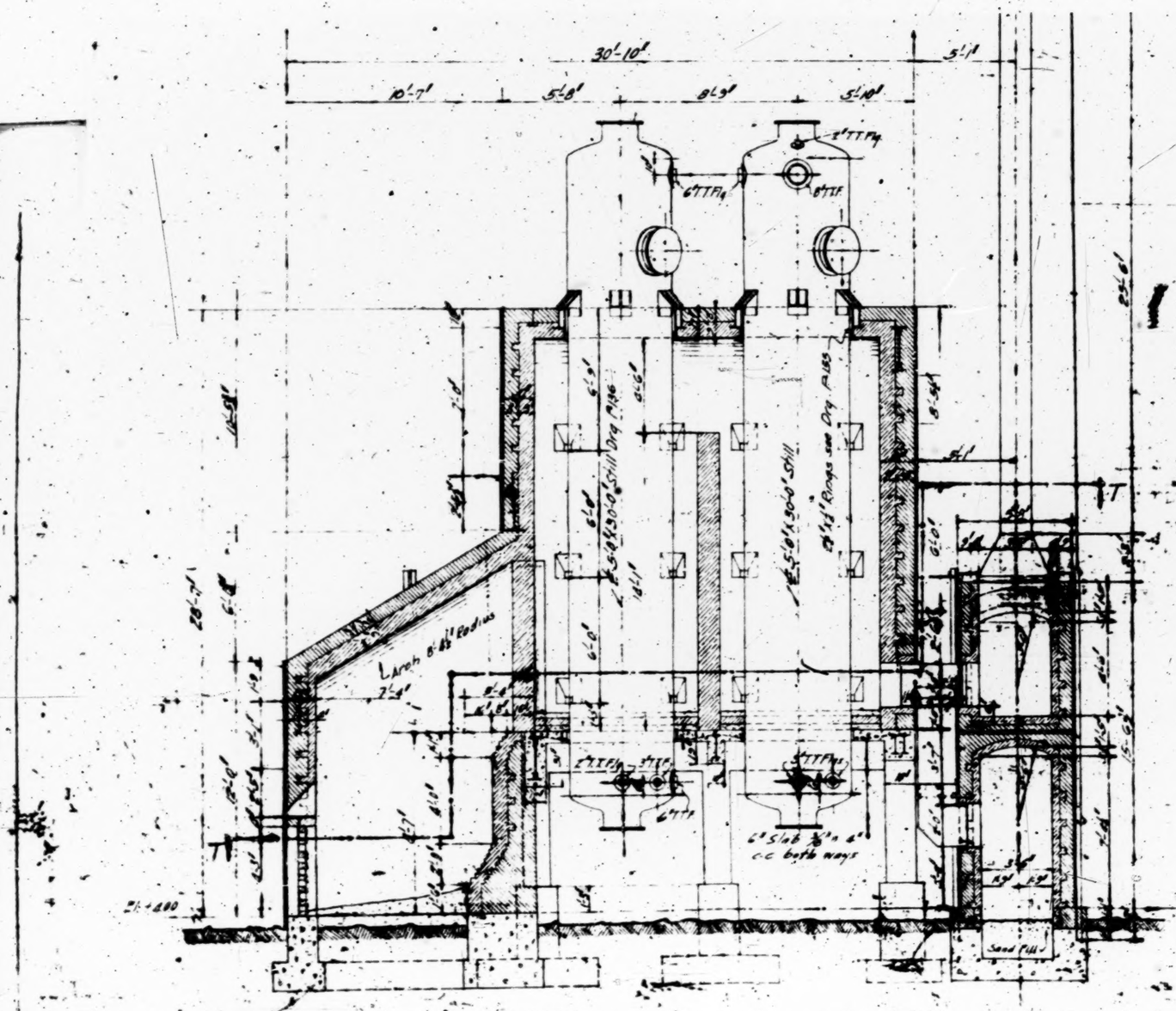
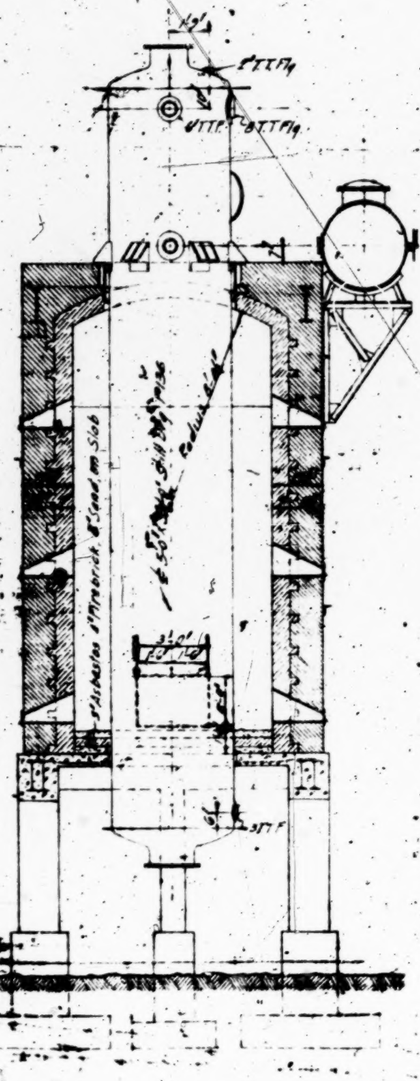


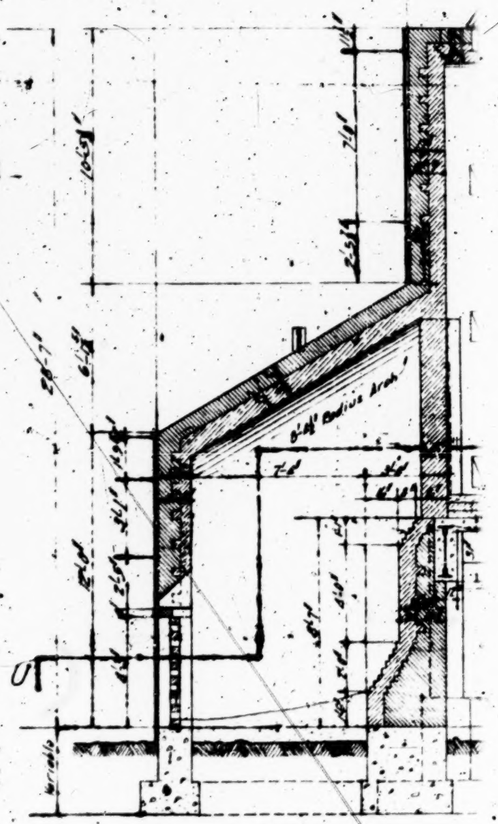
DX 697



SECTION BATTERY No. 2



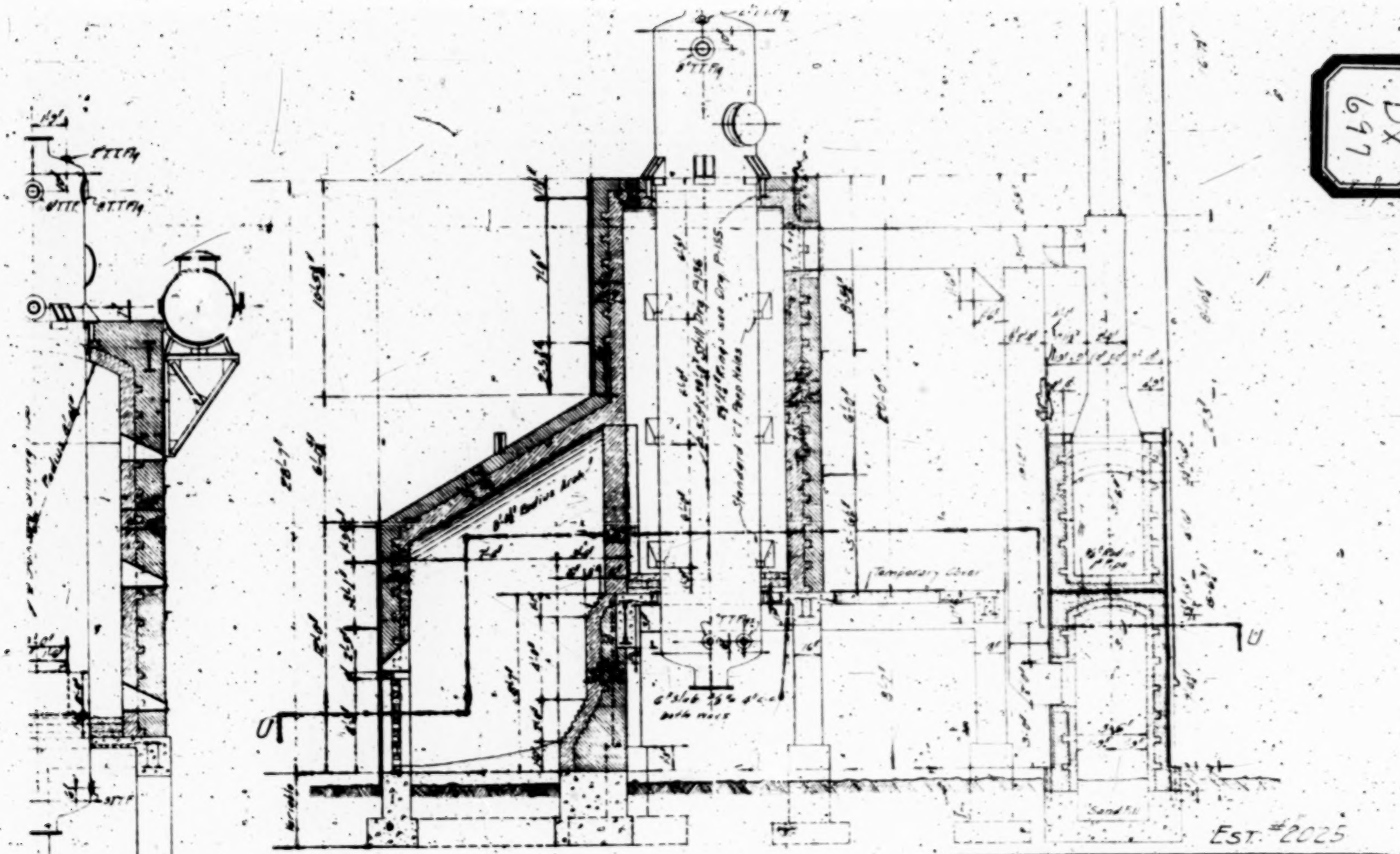
GROSS SECTION BATTERY No. 2



SECTION

NOTE
This dr
drawin

DX 697



SECTION BATTERY No. 3.

'N BATTERY No. 2

NOTE:
This drawing replaces drawing P-149.

EST. #2025

THE TEXAS COMPANY
REFINING DEPARTMENT
HOUSTON, TEXAS.

PLAN AND SECTIONS OF
BATTERIES 2 3 EXP'L STILLS
PORT ARTHUR WORKS.

SCALE: 1/4" = 1'-0"	DATE: 2-24-27	REVISED
DRAWN BY	FILE	PRINT NO. 658377	DRAWING NO. P-169

4511 DX 699.

The Texas Company

Houston, Texas, June 18, 1918.

Estimate No. 2025

Pre-Heater

Mr. F. B. Capen,
Port Arthur, Texas.

Dear Sir:

We are forwarding to-day by Wells Fargo Express, two 2" ammonia return bends, 8" center to center. One of these bends is made of malleable iron, and is furnished by the York Manufacturing Company. This bend is supposed to be for 300# working pressure and is painted grey. The second bend, painted red, is that regularly furnished by the Vilter Mfg. Co. for their extra heavy class of goods, and is also for 300# working pressure. The companion flanges on this latter bend are dropped forged steel. Both bends are equipped with male and female fiange connections and were supposed to have been furnished with corrugated copper gaskets, but we note that one has been furnished with rubber gaskets and the other with lead gaskets, neither of which, of course, will be suitable for our requirements.

We would like to have these flanges tested for both heat and pressure combined, if this is possible. There is no doubt in our mind but what either of these bends would be suitable for any pressure they would be called upon to stand in connection with the experiments which are to be conducted, but as to whether the combination of heat and pressure will affect them any, we do not know and would like to determine. We regret very much that we have been unable to secure these return bends at an earlier date but it was only yesterday that we received the one from the Vilter Manufacturing Company. We had hoped to have secured information and samples from the Crane Co., Clow & Co. and the National Tube Company, but we have been advised through the Purchasing Department that these people have not in stock a class of goods which they could

recommend for use in connection with high pressure, high temperature work; so it will be necessary to do what we can with samples on hand.

In making the pressure test, it might be well to build up pressure as much as the small feed pump, which you have recently installed at the West Side stills, will give them. If we remember correctly, this pump is suitable for pressure of about 700# with 100# steam pressure.

We are also enclosing herewith a pencil sketch showing two types of coils, either of which would be suitable for a pre-heater of the kind we have in mind, if it is possible to assemble with ease and on which we may take up bolts in flanges that may develop leaks after heat and pressure have been applied. Sketch "A" outlines the use of 4512 8" center to center return bends and will provide one and one-half 2" pipe tubes per foot of width per coil. Sketch "B" outlines the use of 6" center to center return bends which will provide two full pipes per foot of width per coil. The only feature in either of these coils which will be undesirable is that of the apparent difficulty which would be encountered in taking up bolts between each layer of coils. Of course, we can design a flange in which all bolts could be reached with a socket wrench but it would take considerable time to get such fittings and we doubt if under existing conditions we could even persuade manufacturers to go to the trouble of running any specials thru their shops. Will therefore thank you to put this question to Messrs. Fox and Witherup with the view of ascertaining, if possible from samples on hand, whether we could use stock fittings and make provision to take up leaks after coil had been put in use, should the coils be installed as outlined on either one of the sketches on attached drawing.

We personally prefer the scheme as outlined in sketch "B": that of using the 6" center to center return bends on horizontal runs and an 8" return bend for a cross-over between end pipes of each run, but we await your reply as to the possibility of taking care of leaks with the arrangement as we have it outlined. We will also have to have an expression from you as to which sample of the return bends stand up the best under test in order that we may arrange to purchase the one which will best serve our purpose.

Yours very truly,

FPR-REB
FTM

F. P. Risdon.

4513 DX 703.

November 23, 1918.

Schuette & Kourting Company,
Philadelphia, Pa.

Gentlemen:

Kindly advise the writer if you are able to supply a Jet Pump with a capacity of handling from ten to fifty barrels per hour of oil at 400° F. against a pressure of 200 pounds per square inch and pick up in addition 75% of the ten to fifty barrels per hour.

Also kindly advise the maximum lift the pump is capable of raising the pick up.

We will require a steel pump for this work because a chemical reaction would soon render brass worthless.

Yours very truly,

Efficiency Engineer.

FBC CEB

4514 DX 704.

(Letterhead of Schuette & Koerting Co., Philadelphia, Pa.) (Stamp) Received Dec 6 The Texas Company Port Arthur Works.

Dec. 2, 1918.

The Texas Company,
Port Arthur, Texas.

Att. Mr. F. B. Capen, Efficiency Engr.

Gentlemen:

Referring to your inquiry of the 23rd ult. concerning a Jet Pump to handle oil at 400° F., we would like some additional information in order to arrive at a clear understanding of your problem.

Do you desire to supply oil under a pressure of 200# to the Jet Eductor (yes) and entrain 75% of oil against a certain counter pressure, the value of which will depend on whether the apparatus can be submerged in the liquid to be lifted or whether a suction lift has to be taken care of (yes). We normally figure on obtaining a counter pressure equal to one-fifth of the available pressure of the entraining liquid in which case, the volumes of pressure oil and entrained oil are about equal. Kindly include in your reply the specific weight (33 B) of the oil to be handled and state whether the liquid to be entrained will also be at a temperature of 400° F. (F. 600-700).

We shall be pleased upon receipt of same, to submit recommendations for suitable equipment, and in the meantime, remain

Yours very truly,
Schutte & Koerting Company,
(Illegible signature),
Jet Department.

REH-AS

4515

DX 705

Experiment 18 — Battery 3, Run 5.
Oil Used: — PBGO.
Apparatus: — Same as B3, R4 excepting preheating coil inserted between economizer & still.

Date of Experiment: — 12/9-10/18.
Date of Tabulation: — 12/14/18.

4522 Experiment 18, B3, R5. Page 4.

Summary:

Pressure		100-125 Lbs.
Temperature of oil		790°-800°.
Temperature of hottest part of furnace		1200°.
Time of run from beginning to end		47 Hrs.
Time of run after conditions		35 Hrs.
Fuel Oil Meters:	To Still	40.1 Bbls.
	To Preheater	17.0 Bbls.
	To Boilers	25.2 Bbls.
Fuel Gas Meters:	To Economizer	13338 Cu. Ft.
	To Preheater	20907 Cu. Ft.

	bbls. Meter	bbls. Guage	% Basis Guage	Grav.
Charge	510.2	502.7	100.00	33.4
Distillate	220.1	205.6	40.91	51.9
Tar	.....	228.7	45.50	31.6
Slop	.....	60.9	12.11	....
Still Bottoms	.....	31.0	6.16	....
Carbon 1886#				
Gas 45064 cu. ft.	.....	—23.5	—4.68	....
Leakage, Error, Etc.				

Note: The excess of products over charge probably due to dreaning of coil and water from steaming out stills.

Fractional Distillation of Distillate 7500 C.C.

	Percent	Gravity	E.P.
N. St. 350	47.55	61.7	352
N. St. 375	53.47	60.0	376
N. St. 400	57.68	58.7	392
N. St. 425	63.88	56.9	422
N. St. 450	69.88	55.4	434
N. St. 475	75.67	53.9	470
Abs. Naph.	4.01	....	...
B. above 475	19.60	33.0	...
Loss Dist.	0.72	....	...

4523 Experiment 18, B3, R5. Page 5.

Summary (Continued):

Yield of Products by Volume Basis Total Charge.

A considerable quantity of oil was drawn from still before working conditions were reached and on account of gasket blowing out, some oil was charged at end to cool still. As a result, the yields below are not based on charge shown in above summary, but upon the total charge 502.7 bbls. less 92.5 bbls. or 410.2 bbls.

		Barrels	Percent	Gravity	E.P.
Distillate:	Naphtha St.—350	97.8	24.39	61.7	352
(205.6 Bbls.)	Naphtha St.—375	109.9	26.80	60.0	376
(50.12%)	Naphtha St.—400	118.6	28.91	58.7	392
(51.9 Grav.)	Naphtha St.—425	131.3	32.02	56.9	422
(598 E.P.)	Naphtha St.—450	143.7	35.02	55.4	434
	Naphtha St.—475	155.6	37.93	53.9	470
	Absorption Naphtha	8.2	2.01	....	...
	Bottoms above 475	40.3	9.82	33.0	...
	Loss Distilling	1.5	0.36	.....	...

Rate of Formation Basis Total Volume of Still 108 Barrels.

			From Beg. to End 47 Hrs.		After Conditions 35 Hrs.	
Product	Grav.	E.P.	Bbls./Hr.	%V of S/Hr.	Bbls./Hr.	%V of S/Hr.
Distillate	51.9	598	4.374	4.050	5.874	5.439
Naphtha St. 350	61.7	352	2.081	1.927	2.794	2.587
Naphtha St. 375	60.0	376	2.285	2.116	3.069	2.841
Naphtha St. 400	58.7	392	2.523	2.336	3.388	3.137
Naphtha St. 425	56.9	422	2.794	2.587	3.751	3.474
Naphtha St. 450	55.4	434	3.057	2.831	4.106	3.802
Naphtha St. 475	53.9	470	3.311	3.065	4.446	4.116

2678 DX 705 (Excerpts from).

Estimation of Carbon Distribution:

Bottom of Still	906 Lbs.
Sides of Still	268 Lbs.
Scrapers	712 Lbs.
Total	1886 Lbs.

4524 / Experiment 18, B3, R5. Page 6.

Summary (Continued):

Gas Formation per hour after running conditions 1287 cu. ft.

Gas Formation per barrel Charge		169.9 cu. ft.
	Distillate	214.3 cu. ft.
	N. St.—350	460.8 cu. ft.
	N. St.—375	410.0 cu. ft.
	N. St.—400	380.0 cu. ft.
	N. St.—425	343.2 cu. ft.
	N. St.—450	313.6 cu. ft.
	N. St.—475	289.6 cu. ft.

Remarks:

The apparatus was same as in Runs 3 & 4 excepting preheater inserted between economizer and still. The object was to heat oil from 750°-800° before introducing into still, so as to reduce the furnace temperature in the still. This temperature was from 200° to 300° F. lower than in former runs.

The Back Trap was run to bottom of still until 4:00 AM 12-10-18 and from then until end of run the back trap ran down vapor line to still. It is rather interesting to note the effects as recorded in record of run.

The coil was examined after run and showed no signs of carbonizing.

The sides of the still were in good condition at end of run and showed no signs of distortion. Some carbon scale at top of still and in bulge at bottom but it did not adhere so fast to still as in former runs.

New Gas Meters were used for fuel and gas formation. They are very satisfactory.

A. H. Behimer.

OKEVA.
RCH(NY)—FTM(HO)—FTM(PA).

DX 705 (Excerpts from)

2679

Experiment 18. Page 1 — Battery No. 2 Run 14. W.S.V.P.S.
Oil Used: — PBGO.
Apparatus: — Same as B2 R13 Excepting Preheater inserted between Economizer and Still.
Date of Experiment: — 12/14-19/18
Date of Tabulation: — 12/23/18

4540 Experiment 18, B2, R14. Page 6.

Test of Products.

	Stock	Distillate	Bottoms Above 475	Tar	Still Bottoms	Naph. St. 350	Naph. St. 375	Naph. St. 400	Naph. St. 425	Naph. St. 450	Naph. St. 475
Gravity	33.4	49.7	33.9	25.5	31.2	62.5	60.7	58.3	56.6	55.1	53.5
Flash	245	....	240	140	195	....	....	....	....	....	....
Fire	290	....	275	200	195	....	....	....	....	....	....
Viscosity	45/100	....	38/100	46/100	45/100	....	....	....	....	....	....
Pour	15	....	0	0	0	....	....	....	....	....	....
Color—18"	....	....	....	....	....	10	12	15	15	15	17
Doctor	....	....	....	....	....	NG	NG	NG	NG	NG	NG
Maumene	9	24	8	....	....	44	39	32	29	29	28
Olefin	....	16.4	16.8	....	....	18.6	18.6	18.2	18.8	18.2	17.8
Distillations:											
Start	436	94	480	400	284	126	128	132	134	138	140
10%	519 38.3	188 78.0	506 38.0	489 39.2	504 41.9	166	168	174	188	192	204
20%	550 37.0	240 67.0	514 37.2	542 33.6	526 36.4	194	198	210	218	228	242
30%	566 35.7	280 64.0	520 36.8	566 32.6	556 35.1	214	222	236	244	258	280
40%	574 35.0	300 62.5	524 35.7	580 30.7	572 34.0	236	242	258	270	288	304
50%	592 34.2	331 58.0	528 34.6	596 29.1	584 33.0	250	262	276	292	314	334
60%	604 33.4	384 52.0	532 34.2	611 28.6	600 32.2	268	282	296	316	338	360
70%	620 33.0	430 46.6	538 33.9	628 27.0	616 31.5	280	302	320	338	358	384
80%	636 32.4	464 40.8	550 33.7	656 25.8	636 30.4	296	320	342	362	384	418
90%	657 30.9	490 37.2	566 32.4	690 24.0	668 29.5	322	344	364	386	412	442
95%	688	519	590	....	705	340	358	372	398	426	464
E. P.	....	550	610	....	....	352	374	394	418	438	472
% Recovered	....	98.0	98.0	....	....	97.0	94.0	97.0	97.0	97.0	97.0

2680 DX 706 (Excerpts from).

Summary:

Average Pressure	130 —140 #.
Temperature of Preheater Coil Outlet	750°-800° F.
Temperature of Oil in Stills	710°-725° F. in bottom of Front Still; 785°-800° F. in all other parts.
Average Temp. of hottest part of Furnace	1120° F.
Time of Run from Beginning to end	104 Hrs.
Time of Run after working conditions	91 Hrs.

		Meter Bbls.	Guage Bbls.
Fuel Oil (PBGO):	To Still	111.2	....
	To Preheater	84.71	....
	To Steam Boiler	73.57	....
	Total	269.48	261.45

Fuel Gas Meter: Preheater .1797 Cu. Ft. (Only used to start oil fire.)
Still & Economizer Did not use.

	Meter Bbls.	Guage Bbls.	% Basis Gauge	Gravity
Charge: PBGO	1959.6	2081.5	100.00	33.4
Distillate	1142.1	1034.2	49.69	49.7
Tar	.....	901.9	43.32	25.5
Slop	.....	None	0.00	....
Still Bottoms	.....	140.0	6.73	31.2
Carbon (3894#)				
Gas (149060 cu. ft.)	.....	5.4	0.26	....
Leakage, Etc.				

DX 706 (Excerpts from).
W 2681

Summary (Continued):

Fractional Distillation of Distillate 7500 C.C. 49.7 Gr.

	Percent	Gravity	E.P.
Naphtha St.—350	42.60	62.5	352
Naphtha St.—375	48.33	60.7	374
Naphtha St.—400	53.00	58.3	394
Naphtha St.—425	58.60	56.6	418
Naphtha St.—450	64.07	55.1	438
Naphtha St.—475	68.87	53.5	472
Absorption Naphtha	3.37	....	...
Bottoms above 475	25.93	33.9	610
Loss Distilling	1.83	....	...

Yield of Products by Volume Basis Total Charge (2081.5 Bbls.)

		Barrels	Percent	Gravity	E.P.
Distillate:	Naphtha St.—350	440.6	21.17	62.5	352
(1032.4 Bbls.)	Naphtha St.—375	499.9	24.02	60.7	374
(49.60%)	Naphtha St.—400	548.2	26.34	58.3	394
(49.7 Grav.)	Naphtha St.—425	606.2	29.12	56.6	418
(550 E.P.)	Naphtha St.—450	662.8	31.84	55.1	438
	Naphtha St.—475	712.4	34.22	53.5	472
	Absorption Naphtha	34.8	1.68	....	...
	Bottoms above 475	268.2	12.88	33.9	610
	Loss Distilling	18.8	0.91	....	...
Tar		901.9	43.32	23.6	...
Slop		None	.....	....	...
Still Bottoms		140.0	6.73	31.2	...
Carbon (3894#)					
Gas (149060 Cu. Ft.)		5.4	0.26	....	...
Leakage, Etc.					

Summary (Continued):

Rate of Formation Basis Total Volume of Both Stills 216 Barrels.

			From Beginning to End 104 Hrs.		After Working Conditions 91 Hrs.	
Product	Grav.	E.P.	Bbls./Hr.	%V of S/Hr.	Bbls./Hr.	%V of S/Hr.
Distillate	49.7	550	9.945	4.603	11.370	5.261
N. St.—350	62.5	352	4.238	1.962	4.843	2.242
N. St.—375	60.7	374	4.807	2.174	5.493	2.543
N. St.—400	58.3	394	5.273	2.440	6.026	2.790
N. St.—425	56.6	418	5.829	2.698	6.662	3.084
N. St.—450	55.1	438	6.375	2.951	7.285	3.372
N. St.—475	53.5	472	6.850	3.171	7.829	3.624

Estimation of Carbon Distribution.

Front Still:	Bottom of Still	15#
	Sides & Scrapers	309#
Rear Still:	Bottom of Still	1706#
	Sides & Scrapers	1864#
Total		3894

Gas Formation Total	149060 Cu. Ft.
Gas Formation per hour after conditions	1638 Cu. Ft.
Gas Formation per barrel of Charge	71.6 Cu. Ft.
Gas Formation per barrel of Distillate	144.1 Cu. Ft.
Gas Formation per barrel of N. St.—350	338.3 Cu. Ft.
Gas Formation per barrel of N. St.—375	298.3 Cu. Ft.
Gas Formation per barrel of N. St.—400	265.7 Cu. Ft.
Gas Formation per barrel of N. St.—425	246.0 Cu. Ft.
Gas Formation per barrel of N. St.—450	224.9 Cu. Ft.
Gas Formation per barrel of N. St.—475	209.3 Cu. Ft.

DX 706 (Excerpts from)

Summary (Continued):

Remarks:

The temperature of Air Condensers with Mercury Thermometers (HG) were incorrect until 2:00 AM 12-18-18. New Thermometers were put in at that time and the readings are more consistent.

The run was very uniform from beginning to end, as you can note from record of run, and the results better than any former run. The Preheater relieves the strain on the front still by lowering the furnace temperature. But every change in one part of the apparatus calls for a change in some other part of the apparatus. The reduced furnace temperature on the front still does not, apparently, give quite enough heat for the rear still. The preheater is going to eliminate the idea of heating a battery of stills by letting furnace heat pass from one still to another. It is going to require either auxiliary fires on rear still or separate furnaces for each still.

The Air Condensers are too small and that accounts in part for the low gravity product. They should be at least twice as large to run 12 to 14 barrels of 52-54 gravity distillate.

Carbon: The inside surface of the front still was entirely covered with a thin scale from 1/16" to ⅛" thick. A few small particles of scale where the belly was pounded back was ¼" thick.

The scale was not nearly so hard on rear still.

We must get busy on a jet that will force the back trap through the preheater. The capacity of the present preheater is about 20-25 barrels per hour. We need some experimental data so the jet and preheater can be proportioned.

A. H. Behimer.

OB-EVA.

RCH(NY)—FTM(HO)—FTM(PA).

DX 706 (Excerpts from).

Experiment 18, Battery 3, Run 7.
Oil Used: PBGO.
Apparatus: Same as in B3, R5.
Date of Experiment (Start): 1-11-19.
Date of Tabulation (Start): 1-13-19.

4555 Experiment 18, B3, R7, Page 5.

Summary:

Average Pressure	120 —140 Lbs.
Temperature Preheater Oil Outlet	800°—825°.
Temperature of Oil in Still	790°—825°.
Temperature Hottest Part of Furnace	1200° Approx.
Time of Run from beginning to end	51 1/6 Hrs.
Time of Run after Working Conditions	38 1/6 Hrs.
Fuel Oil (Meters) To Still	40.12 Bbls.
(PBGO) To Preheater	35.5 Bbls.
To Boiler	37.5 Bbls.
Total Fuel Oil (Meters)	113.12 Bbls.
Total Fuel Oil (Gauges)	110.57 Bbls.
Fuel Gas	None used.

	Meter Barrels	Gauge Barrels	% Basis Charge	Gravity
Charge	729.5	692.3	100.00	32.7
Distillate	360.3	328.0	47.38	52.0
Tar	....	298.5	43.11	27.4
Slop	.....	10.7	1.55	....
Still Bottoms	.....	66.3	9.57	26.5
Carbon 2352 Lbs.				
Gas 58580 cu. ft.	.....	—11.2	—1.61	....
Leakage, Etc.				

DX 707 (Excerpts from).

Fractional Distillation of Distillate 7500 C.C.

	Percent	Gravity	E.P.
N. St.—350	46.81	61.8	358
N. St.—375	51.98	60.3	374
N. St.—400	58.30	57.5	392
N. St.—425	63.43	57.2	414
N. St.—450	69.90	54.6	432
N. St.—475	76.13	53.8	452
Abs. Naph.	4.36	....	...
B. above 475	17.13	34.0	...
Loss Distilling	2.38	....	...

4556 Experiment 18, B3, R7. Page 6.

Summary (Continued):
Field of Products by Volume Basis Total Charge 692.3 Barrels.

		Barrels	Percent	Gravity	E.P.
Distillate:	Naph. St.—350	153.6	22.18	61.6	358
(328.0 Bbls.)	Naph. St.—375	170.6	24.64	60.3	374
(47.38%)	Naph. St.—400	191.2	27.62	57.5	392
(52.0 Grav.)	Naph. St.—425	208.1	30.06	57.2	414
(550 E.P.)	Naph. St.—450	229.4	33.14	54.6	432
	Naph. St.—475	249.8	36.08	53.8	452
	Abs. Naph.	14.26	2.06	....	...
	B. above 475	56.14	8.11	34.0	...
	Loss Distilling	7.75	1.12	....	...
Tar		298.5	43.11	27.4	...
Slop		10.73	1.55	....	...
Still Bottoms		66.3	9.57	26.5	...
Carbon 2352 Lbs.					
Gas 58580 cu. ft.		—11.2	—1.61	....	...
Leakage, etc.					

Rate of Formation Basis Total Volume of Still 108 Barrels

			From Beg. to End 51 1/6 Hrs.		After Conditions 38 1/6 Hrs.	
Product	Grav.	E.P.	Bbls./Hr.	%V of S/Hr.	Bbls./Hr.	%V of S/Hr.
Distillate	52.0	550	6.409	5.934	8.593	7.956
N. St.—350	61.6	358	2.996	2.774	4.017	3.719
N. St.—375	60.3	374	3.310	3.064	4.463	4.132
N. St.—400	57.5	392	3.732	3.455	5.004	4.633
N. St.—425	57.2	414	4.061	3.760	5.445	5.051
N. St.—450	54.6	432	4.475	4.143	6.000	5.555
N. St.—475	53.8	452	4.875	4.514	6.535	6.051

2686

DX 707 (Excerpts from).

Summary (Continued):

Gas Formation Total	58580 Cu. Ft.	Carbon Distribution:	
Gas Formation per hour.	1534.8 Cu. Ft.	Carbon in Bottom of Still	1017 Lbs.
Gas Formation per barrel of Charge	84.6 Cu. Ft.	Carbon on Scrapers & Sides.	1335 Lbs.
Gas Formation per barrel of Distillate	178.6 Cu. Ft.	Carbon in Overflow Drum	....
Gas Formation per barrel of N. St.—350	381.4 Cu. Ft.		
Gas Formation per barrel of N. St.—375	343.5 Cu. Ft.	Total Carbon	2352 Lbs.
Gas Formation per barrel of N. St.—400	306.5 Cu. Ft.		
Gas Formation per barrel of N. St.—425	281.5 Cu. Ft.		
Gas Formation per barrel of N. St.—450	255.4 Cu. Ft.		
Gas Formation per barrel of N. St.—475	234.6 Cu. Ft.		

Dimensions of Bellies on Lower Part of Still in Furnace:

	Circumference Extent	Longitudinal Extent	Depth
Upper Belly	4'-8"	2'-4½"	0'-1½"
Lower Belly	7'-4"	4'-2"	0'-2¼"

Remarks:

This run is especially interesting because it is the first time any battery of stills on Experiment 18 has approximated results obtained on small experimental stills, Exp. 11A. It not only shows what can be done with a single still, but also shows what results can be expected on battery of two or more stills. By comparison with Experiment B2, R16, you will see that the rate of formation of naphtha in this run is almost equal to the rate of formation of naphtha in B, R16. The still volume of Battery 2 is twice that of Battery 3 and the rate of decomposition should be and will be approximately twice as rapid when the proper temperatures are obtained in all parts of the oil in the still and the Air Condensers increased in size.

The furnace temperature in this battery is still too high. The temperature of oil in bottom of still was from 810°-825° F. and the furnace temperature approximately 1200° F. The still buckled in two different places at the bottom of the still. On inspection of the carbon deposit, it was found that the first buckling took place when the carbon scale was between 5/16" & 6/16" thickness. The still probably would never have buckled so soon if one of the cables holding one half of the scrapers had not broken some time during the run and also if the still had not been distorted by some of the very first runs so the scrapers could not work effectively. The buckles must be pounded back before further use of this still.

In the next experiment, an attempt will be made to jet the back trap through the preheater. This will probably permit another reduction in furnace temperature and lessen the strain on the still inside the furnace.

A. H. Behimer.

OB-EVA
RCH(NY)—FTM(HO)—FTM(PA)

DX 707 (Excerpts from).

4558 **DX 708.**

Experiment 18.
Est. 2000
Date 2/25/19
Run B3R8
Time of Run—47 hours

Apparatus: Same as experiment B3R7, excepting jet pump introduced between Economizer coil outlet and Preheater Coil.
Oil Used: P. G. B. O.

4568 **Summary**

Experiment 18. B3. R8. Page 5.

Average Pressure	120 Lbs.
Temp. Preheater Coil Outlet	800-850 F.
Temp. Oil Stills	790-820 F.
Temp. Hottest part of Furnace	1300
Time of Run from beginning to end	47 hours
Time of Run under working conditions	35½ hours

	Meter	Gauge
Fuel Oil—Still	....	48.5
Preheater	41.38	....
Boiler	46.33	....
Total		136.2

Note: No gas used.

	Meter Bbls.	Gauge Bbls.	% Basis Charge	Gravity
Charge	752.1	735.4	100.00	32.5
Distillate	326.7	298.9	40.64	51.2
Tar	.....	350.4	47.65	26.4
Slop	.....	0.9	0.12	....
Still Bottoms	.....	72.9	9.91	25.0
Gas (Not determined)				
Carbon)				
Leakage, etc.)		12.3	1.68	

Fractional Distillation of 7500 C.C. Distillate

	Percent	Grav.	E.P.
Naph. St. 350	45.66	61.2	368
Naph. St. 375	51.67	59.5	378
Naph. St. 400	57.74	57.7	396
Naph. St. 425	62.14	56.6	414
Naph. St. 450	69.09	55.0	438
Naph. St. 475	74.19	53.4	458
Abs. Naph.	5.13	....	....
Bottoms above 475	20.47	33.0	648
Loss Distilling	0.21	....	....

Yield of Products Basis Total Charge 735.4 Bbls.

		Barrels	Percent	Grav.	E.P.
Distillate	Naph. St. 350	136.5	18.56	61.2	368
(268.9 Bbls.)	Naph. St. 375	154.4	21.00	59.5	378
(40.64%)	Naph. St. 400	172.5	23.46	57.7	396
(51.2 Grav.)	Naph. St. 425	185.7	25.25	56.6	414
(590 E.P.)	Naph. St. 450	206.5	28.08	55.0	438
	Naph. St. 475	221.7	30.15	53.4	458
	Abs. Naph.	15.3	2.08	....	...
	Bottoms Above 475	61.2	8.32	33.0	648
	Loss Distilling	0.7	0.09	....	...
Tar		350.4	47.65	26.4	
Slop		0.9	0.12	....	...
Still Bottoms	.....	72.9	9.91	25.0	...
Gas (Not determined))					
Carbon)		12.3	1.68	....	...
Leakage, etc.)					

4569 Summary (2)

Exp. 18. B3 R8

Rate of Formation Basis Total Volume of Still 108 Barrels

			From Beginning to End 47 Hrs.		After Working Conditions 35½ Hrs.	
Product	Grav.	E.P.	Bbls./Hr.	%V of S/Hr.	Bbls./Hr.	%V of S/Hr.
Distillate	51.2	...	6.359	5.888	8.420	7.796
Naph. St. 350	61.2	368	2.904	2.689	3.845	3.560
Naph. St. 375	59.5	378	3.289	3.045	4.349	4.027
Naph. St. 400	57.7	396	3.670	3.398	4.859	4.449
Naph. St. 425	56.6	414	3.951	3.658	5.231	4.843
Naph. St. 450	55.0	438	4.393	4.068	5.817	5.386
Naph. St. 475	53.4	458	4.717	4.368	6.245	5.782

Measurement of buckles on lower part of still with straight edge.

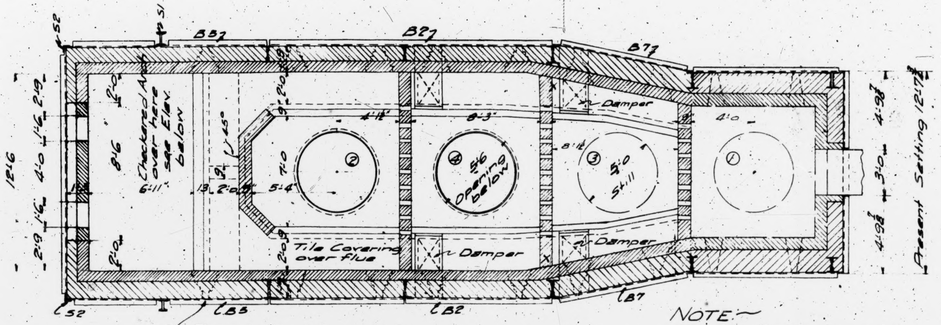
	Lower Buckle	Upper Buckle
Depth	0'— 4¼"	0'— 2¼"
Circumferential Extent	4'— 8 "	4'— 8 "
Vertical Extent	9'—10 "	9'—10 "

Remarks:

The object of the experiment was to try out jetting back trap through the preheater coil. The resistance in the coil was approximately 18 Gauge pressure. This resistance was too great for this jet to pick up all the back trap. Approximately 8 bbls./hr. is rate flow of Back trap and the jet was picking up only approximately 2 bbls./hr. As a result approximately 6 bbls./hr. was run down vapor line to still.

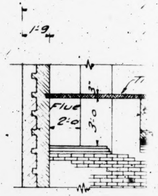
A. H. Behimer.

OB-BAD 4/10/19
RCH(NY)—FTM(HO)—FTM(PA).



SECTION ON LINE "B-B"

NOTE:—
Present steel columns at points marked X to be cut off flush with top of platform at elevation +12'6



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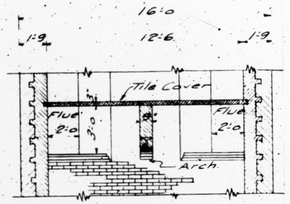
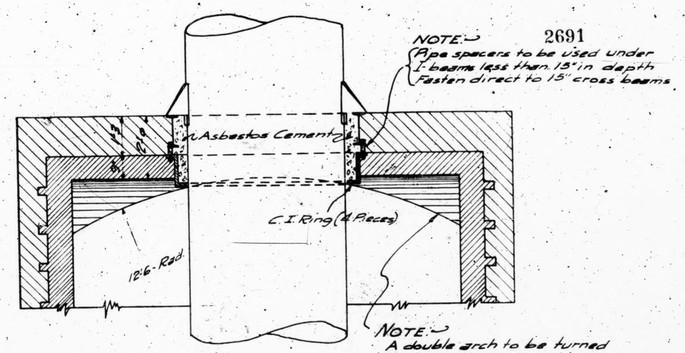
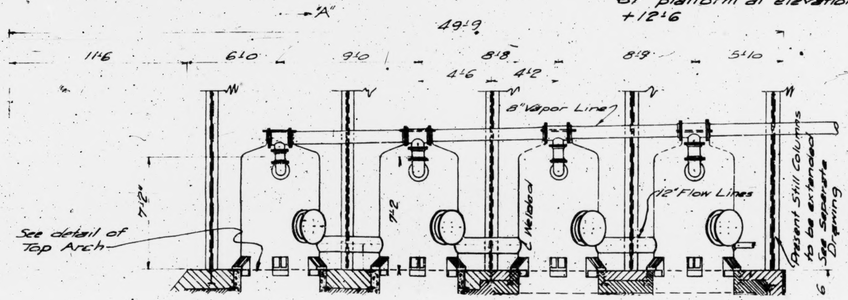


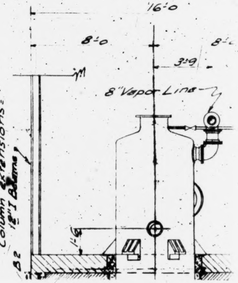
—SECTION "C-C"—

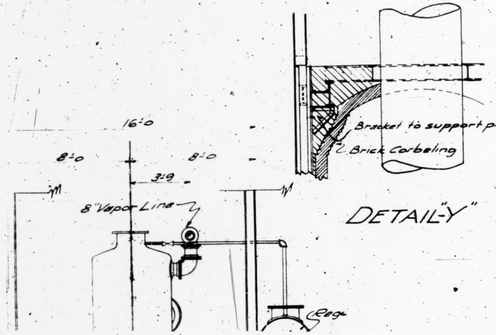


NOTE:—
A double arch to be turned around still @ 12'6 radius

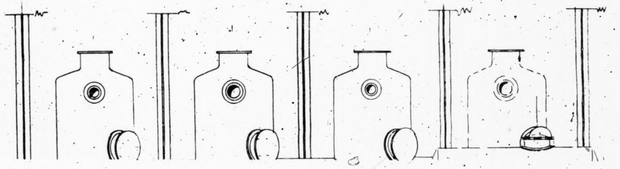
—DETAIL OF TOP ARCHES—
—Scale: 1/2" = 1'-0—

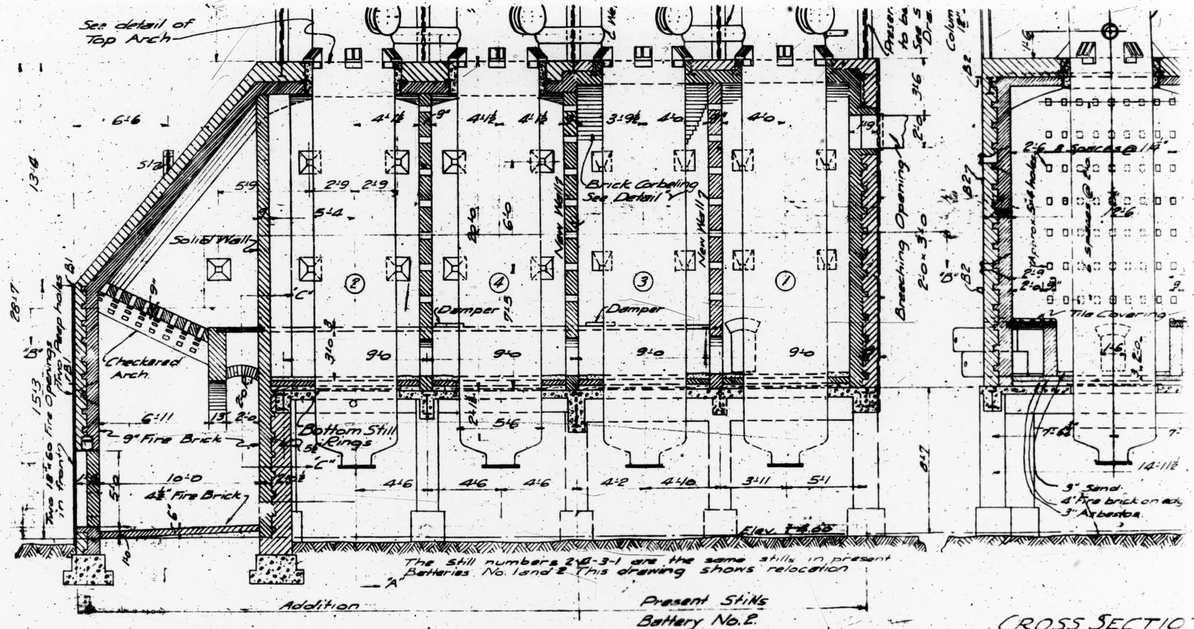




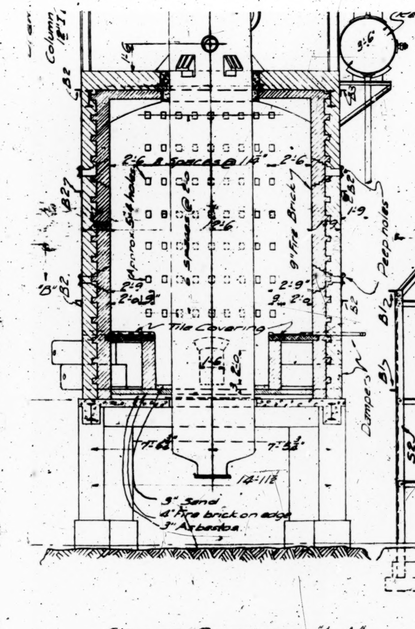


DETAIL "Y"

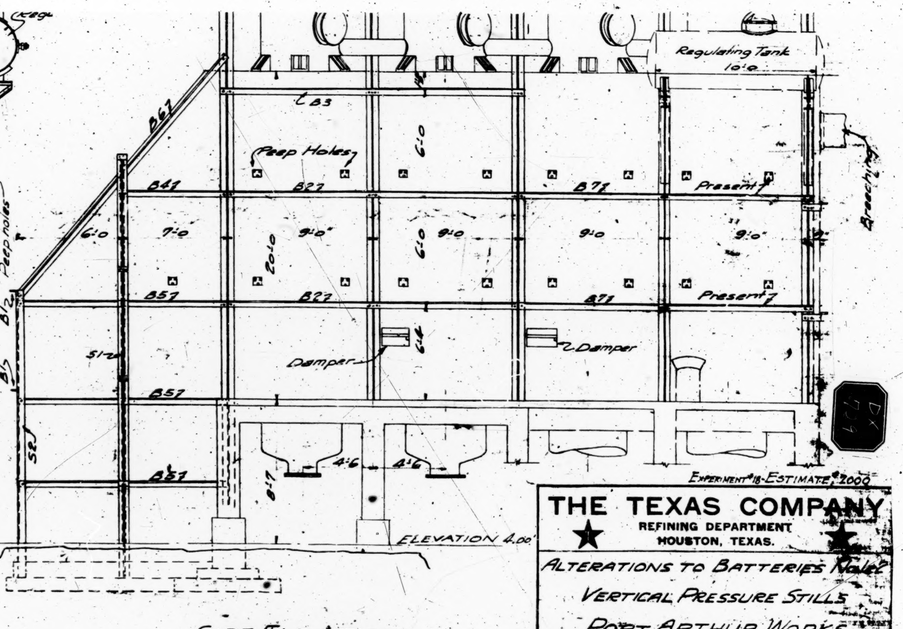




LONGITUDINAL SECTION



CROSS SECTION A-A"



SIDE ELEVATION

EXPERIMENT # - ESTIMATE # 2000

THE TEXAS COMPANY
REFINING DEPARTMENT
HOUSTON, TEXAS.

ALTERATIONS TO BATTERIES Nos. 1 & 2
VERTICAL PRESSURE STILLS
PORT ARTHUR WORKS

SCALE: 1" = 1'-0"	DATE: 12-4-18	REVISED:
DRAWN BY	FILE	PRINT NO.	DRAWING NO.
Dennis	CHK.	58305	

4571 DX 710-a.

(Letterhead of The Hancock Inspirator Co., New York.)

March 29, 1919.

In reply refer to
WJHM/FVG

Mr. Otto Behimer
c/o Texas Company
Port Arthur, Texas.

All agreements are contingent on strikes, accidents, or other causes beyond our control, prices are subject to change without notice, and are made for prompt acceptance.

Dear Sir:

(1) Referring to your recent visit to this office and to our Boston Factory, we have this date received the following letter from our Mr. B. T. Williston:

"An Agent connected with the Texas Oil Company came to see us about a special Ejector to be used with oil under a pressure of 175 lbs. motive power with oil at the suction of 100 lbs. at temperature of 600 degrees to obtain a delivery pressure of 125 lbs.

As we had no conditions of this description to test by we used two Injectors, one furnishing the water power 175 lbs., and the inlet suction approximately 100. Conditions are not exactly the same, as the motive power stream would not be very solid owing to its temperature. Our increase of back pressure over the pressure of the suction water was 10#. Very likely this may be increased under the conditions specified.

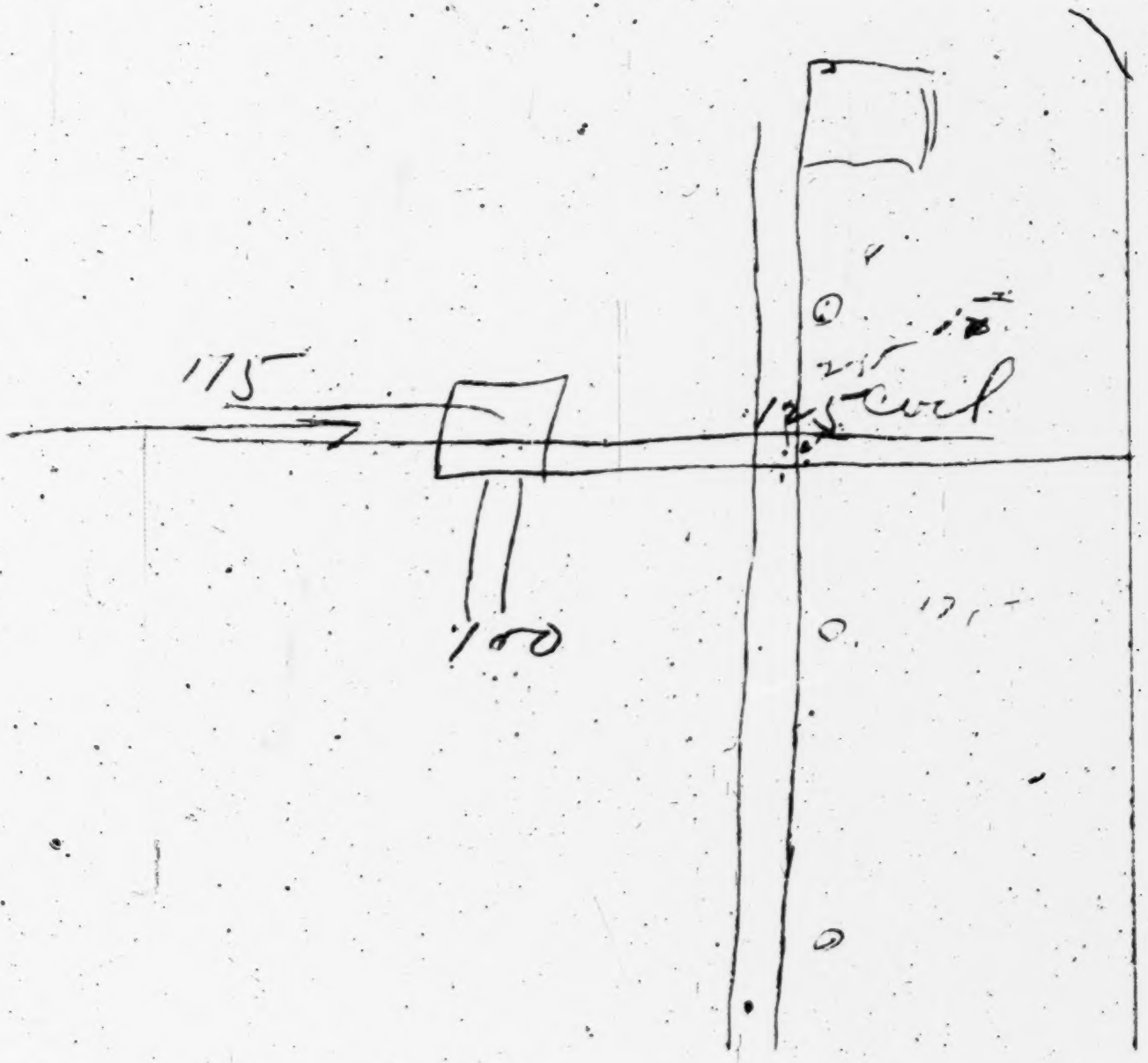
In order to prove this we believe a steel Injector should be made with steel tubes, as the temperature and the pressure are such that composition would not be safe. Then, again, the oil has more or less sulphur in it and it would corrode a composition Ejector. To positively test this it should be put under the conditions specified by the representative of the Oil Company. We could make this

out of steel by having a forging made and finishing it to the dimensions that we used in our test."

(2) Before we go ahead with this experimental work we would like to know, how many of these special Injectors you would need and if you would be willing to stand the initial
cost of manufacturing them. This to include experi-
4572 mental work and special tools which will have to be made.

(3) We hope Mr. Williston's report will be clear to you and that we can make some machines which will do your work.

Yours very truly,
The Hancock Inspirator Company,
W. J. H. Miller,
Eastern Sales Department.


175
100

4574 DX 710-b.

Port Arthur, Texas, April 21, 1919.

Jet Pump

Ref: W. J. H. Miller /F.V.G./ 3/29/19

Mr. Miller,
The Hancock Inspector Co.,
119 W. 40th St.,
New York City.

Dear Sir:

As you suggested, I visited your factory at Boston, and had the pleasure of meeting Mr. Williston and Mr. Dobson in respect to the Jet Pump. They advised me that it would be necessary to do some experimenting before any definite statement, also that they were not equipped to exactly duplicate our temperature conditions; and that it would be better for them to do a little preliminary experimenting and then make up an ejector and send us to try out under actual working conditions. I assured them, that we would be glad to cooperate with them in perfecting an ejector to meet our conditions; that we would test out the ejector under working conditions and report results back to them so that they could make changes and improvements in the ejector.

The proposition is to find out whether an ejector can do our work. I believe you understand our problem and, with your experience in similar types of apparatus, you will not have much difficulty in making an ejector suitable for our purposes.

4575 The working conditions are as follows:

(1) Motive power 16 bbls. oil per hour at 175# Gauge pressure @ 300° F.

(2) Suction or pick up 8 bbls. oil per hour at 100# Gauge Pressure @ 600°F.

(3) Discharge 24 bbls. oil per hour at 125# pres. @ .....

As your Boston office suggested, the jet should be made of steel so it can be connected to a 2" line at motive power end, a 3" line at the suction end, and a 2" line at the discharge end. Also it would be advisable to make the body of the ejector so that different sized inlet and discharge tubes can be placed and replaced in the body of the ejector.

If these ejectors work, we will require a dozen or more now, but if they don't work we do not need any. For that reason it will probably be better for you to give us an approximately idea of the initial cost and experimental charge before going any farther. Mr. Williston gave me the impression that this would not be excessive and that being the case, we shall be very anxious for an early reply so we can get something started.

Yours very truly,

OB.

OB-BAD

4576' DX 710-c.

(Letterhead of The Hancock Inspirator Co., Chicago, Ill.)

May 6, 1919.

The Texas Company,
Port Arthur, Texas.

Attention Mr. Otto Behime

Subject: Jet Pump.

Gentlemen:

Referring to your esteemed favor of April 21st, addressed to our New York Office, which has been referred to us for attention, as we regularly handle from this point all business from your section of the country, intended for our company, we would state that our factory people have very thoroughly gone over the conditions outlined in your letter and they suggest that as they are unable to rig up under these conditions to conduct a test, without involving a great deal of expense, they recommend your purchasing one of our small Ejectors and testing it under the working conditions which you have specified. A small Ejector costs but very little money and you could test it under any conditions you desire.

We believe that one of our Brass Ejectors would last through your tests and, should it develop that you needed a change in either of the jets, this change could readily be made. After you have satisfied yourselves with regard to its working qualities, we could make an Ejector of Steel, with tubes of steel or nickle, which would adequately meet your requirements and which would give you the results which you are striving for.

We are sending you, under separate cover, copy of our latest catalog, and refer you to page 30, listing our regular Hancock Ejectors, therefore, if you will please advise us the size desired to conduct this experiment, we shall arrange for prompt shipment.

Our price to you for the Ejectors specified on this page is 60% discount from list prices given.

Our regular terms are: 30 days net or 2% for cash in 10 days, payable in New York funds, F. O. B. Boston, Mass. Should we find it impossible to make shipment from our Accommodation Stock here in Chicago, our terms of delivery, of course, would be F. O. B. Chicago, Ill.

4577 Hoping we may hear favorably from you at your earliest convenience, we remain

Yours very truly,

The Hancock Inspirator Co., Sales Dept.,

By E. L. Berthold.

ELB:L R.

Catalog.

4578 DX 711.

Experiment	18. B4 R3 Estimate 2000
Kind of Oil:	P. Base Gas Oil
Apparatus:	Same as previous run, excepting furnace changes: Preheater pi vided with separate stack. Still furnace opened up with large breaching to stack through top flue. All baffles between stills torn down and checkers above combustion chamber covered up to increase draft through conduits.
Date of Experiment	11 20 PM 4/15/19 to 6 00 PM 4/16/19
Date of Report	4/16/19

4597 Experiment 18. B4. R3 Est. 2000 Page 7

Summary

Time coming to working conditions 22¾ hours
Time under working conditions 64 hours
Time from beginning to end of Run 86¾ hours

		Meter Bbl.	Gauge Bbl.
Fuel Oil:	Stills	127.65	....
	Preheater	94.74	....
	Boiler	96.93	....
	Total	319.32	297:1

	Meter Bbls.	Gauge Bbls.	% Basis Gauge	Gravity
Charge	2401.6	2394.2	100.00	31.5
Distillate	1220.7	1113.6	46.51	49:9
Slop	.....	6.7	0.28	....
Tar	.....	1063.6	44.42	27.9
Still Bottom		234.3	9.79	27.1
Gas (Not determined))				
Carbon, Etc.)		24.0	1.00	....

Fractional Distillation of Distillate 7500

		Percent	Grav.	E.P.
Naphtha	St.—350	45.49	60.2	362
	St.—375	49.29	58.6	374
	St.—400	60.56	55.2	408
	St.—425	66.09	53.8	412
	St.—450	72.09	51.7	434
	St.—475	78.76	50.5	452
Abs. Naph.		4.47		
Bottoms Above 475		12.93		
Loss Distilling		3.84		

Yield of Products by Volume Basis Total Charge 2394.2 Bbls.

		Barrels	Percent	Grav.	E.P.
Distillate	N. St. 350	506.6	21.16	60.2	
(1113.6 Bbl.)	N. St. 375	548.8	22.92	58.6	
(46.51%)	N. St. 400	674.4	28.17	55.2	
(49.9 Grav.)	N. St. 425	736.0	30.74	53.8	
(580 E.P.)	N. St. 450	802.8	33.53	51.7	
	N. St. 475	877.0	36.63	50.5	
	Abs. Naphtha	49.8	2.08	....	
	Bottoms Above 475	143.9	6.01	32.8	
	Loss Distilling	42.9	1.79	....	
Slop		6.7	0.28	....	
Tar		1063.6	44.42	27.9	
Still Bottoms		234.3	9.79	27.1	
Gas (not determined))					
Carbon, etc.)		24.0	1.00	....	

Rate Formation of Products Basis Total Volume of 4 Still 432 Barrels

Product	Grav.	E.P.	Beg. to End 86⅞ Hrs. Bbls./Hr.	%V of S/Hr.	After Conditions 64 Hrs. Bbls./Hr.	%V of S/Hr.
Distillate	49.9	580	12.85	2.974	17.4	4.028
N. St.—350	60.2	362	5.847	1.353	7.916	1.832
N. St.—375	58.6	374	6.332	1.466	8.575	1.985
N. St.—400	55.2	408	7.782	1.801	10.54	2.440
N. St.—425	53.8	412	8.492	1.966	11.50	2.662
N. St.—450	51.7	434	9.263	2.144	12.54	2.903
N. St.—475	50.5	452	10.12	2.343	13.70	3.171

4598 Experiment 18 B4 R3

Summary (Continued)

Carbon Distribution at End of Run by Stills

	Still—1 Lbs.	Still—2 Lbs.	Still—3 Lbs.	Still—4 Lbs.
Bottoms of Stills	50	114	909	1147
Sides of Still & Scraper	100	594	1163	853

Remarks:

The apparatus same as previous run, excepting furnace changes. The checker work above combustion chamber was closed up so that the front still would be heated by radiant heat and the rear stills be heated by the gases of combustion coming through the conduits at bottom of furnace. The metal breeching was torn out and a much larger brick breeching put in from about middle of rear end of furnace to top flue leading to stack. The preheater furnace breeching was disconnected from flue and a separate stack put in.

The operation was same as previous runs. All the charge was run to front still and also all the back trap was run to the front still.

The oil temperatures of the stills at bottom and top were checked at different times during the run with Standard thermometers and these readings are given below together with the instrument readings for comparison.

Date	Position	Still—1 Std. Ther.	Still—1 Inst.2 Ther.	Still—2 Std. Ther.	Still—2 Inst. Ther.	Still—3 Std. Ther.	Still—3 Inst.2 Ther.	Still—4 Std. Ther.	Still—4 Inst.2 Ther.
4-16-19 10-11 AM	Top of	685	720	725	740	728	750	723	730
4-17-19 3-5 PM	Top of	744	780	764	770	762	770	754	760
4-17-19 2-3 PM	Bot. of	699	702	757	759	760	745	739	760
4-18-19 9-11 AM	Top of	755	790	770	780	773	790	740	750
4-18-19 9-11 AM	Bot. of	736	...	780	...	782	...	753	775
4-19-19 9-11 AM	Top of	746	795	762	760	765	790	755	780
4-19-19 9-11 AM	Bot. of	674	680	772	...	773	...	750	772

Note: In the four last lines of readings the top and bottom temperatures of each still was taken at the same time so they show the actual difference in temperature of bottom and top of still at the time of taking reading.

The furnace was a great improvement over previous one. There is probably not enough heat in back stills; but if the engineering department makes another improvement as they expect to do this next run, there will be no question about getting good results out of a battery of four stills. More heat is necessary in the back stills before the back trap and charge can be split between the three front stills.

The preheater is not large enough. Another 2" preheater is being put in. Two 2" preheaters will be enough to heat the charge for a four still battery when running at the rate of 25 to 30 bbls. distillate per hour; but the resistance in the pipe will eliminate the idea of jetting the back trap through the preheater, on account of high resistance through the coils. For this reason a 3" preheater ought to be installed as soon as possible for experimental purposes.

The Air Condensers are not nearly large enough. They will only separate about 14-16 Barrels per hour of distillate 52-54 Be gravity. They ought to be twice as large for the next run, the two air condensers of battery 3 will be placed in battery 4, making a pair of triple air condensers on Battery 4.

The oil level in the stills works good and at the present time the chief obstacles are furnace, air condensers and preheater.

4599 Battery 3 Runs 7 & 8, are the only experiments so far performed in which the furnace temperature conditions could be so controlled and in which the air condensers and preheater were near enough proportioned to warrant any suitable information as a basis of estimating the capacity of a battery of four stills and the size of air condensers and preheater required. Taking the results of these experiments as a basis, a fairly good estimate can be made of the requirements for the new equipment of four still Batteries and that there may be no misunderstanding, a few requirements for the new batteries of four stills will be given below, based on the results of experiments so far performed.

(1) Pumps, Meters Exchanges, Economizers and preheaters should be provided to handle a charge of 60 bbls of oil per hour under working conditions.

(2) The air condensers should be provided large enough to separate 30 Bbls. distillate 52 to 54 gravity per hour under working conditions. Battery 3 will separate 7 to 8 bbls. of distillate per hour under working conditions. That

is to say the air condensers of the 4 still battery should have four times as large air condensers as battery 3.

(3) There should be left space for two 3" preheaters to each battery. One 3" preheater will probably heat the charge but if the back trap is to be jetted through the preheater if will be necessary to have two 3" preheaters.

(4) There are a great many ways these stills could be operated and get fairly good results; but if the best results are to be obtained these stills must be operated so as to maintain the desired cracking temperatures in every part of every still. There are probably only two ways in which this result can be accomplished depending upon the handling of the back trap.

Method 1.

(A) When the back trap is run directly from the heavy air condenser to the still i. e. without running through the preheaer, the best method of operating would probably be to preheat the charge 800-850° F and split the charge between stills 1, 2 & 3; draw tar from the bottom of still 4; connect the stills at top as in present battery by 12" oil over-flow line and 12" vapor line; take the vapors off still 4; run the back trap down the vapor line; but to prevent the back trap from running into still 4 connect a back trap line from vapor line next still to top of still 1.

The advantages of this method (1)

(1) The temperature condition can be maintained in all parts of the still; for it cuts off the cooling effect of the back trap on the bottom of the still.

(2) Fuel economy. The back trap cools the hot vapors coming directly from the still.

(3) The carbon formation is split up between stills 1, 2 & 3.

The Disadvantages of method 1.

(1) Promotes the formation of Kerosene and will require greater pressure to run a given gravity products.

(2) Cuts off agitation and mixing of oil in stills consequently greater tendency for carbon formation in bottom of stills.

4600 Method 2.

When the back trap is jetted by the charge through the preheater, the best method of operating is to heat the charge and back trap 800-850° F and split the charge between stills 1, 2 and 3; draw tar from bottom of still 4;

connect the stills at top as in present battery by 12" oil over flow and 12" vapor line; take the vapors off still 4.

The advantages of method 2:

(1) The temperature conditions can be maintained in all parts of the stills.

(2) The back trap is blended with the charge and heated to 850. The cracking of the back trap is promoted not only by its passage through the coil but also by the passage up through the hot oil in still.

(3) It splits the carbon formation between stills 1, 2 & 3 and prevents to a greater extent the deposit of heavy oil and carbon in the bottoms of stills 1, 2 and 3.

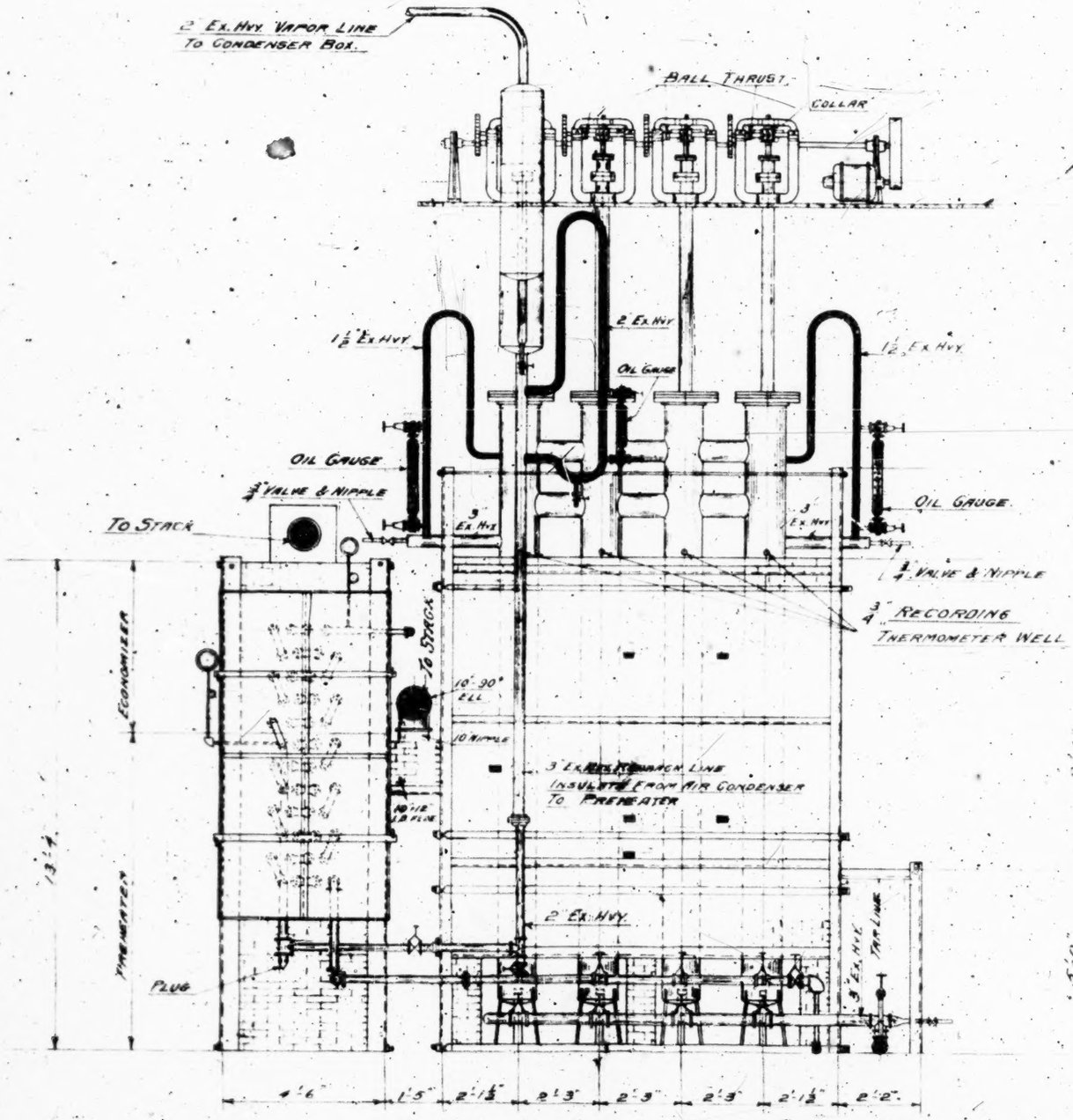
(4) It is an internal heating scheme and makes possible a lower furnace temperature.

Method 2 is in my opinion the best method of all; at present the jet pump has not been worked out. It will require some experimenting with a 3" coil and jet pump before it will be ready, for that reason it seems to me it is advisable to plan space in the new equipment for two 3" preheaters with each battery of 4 stills, then when the jet pump is developed it can be easily installed.

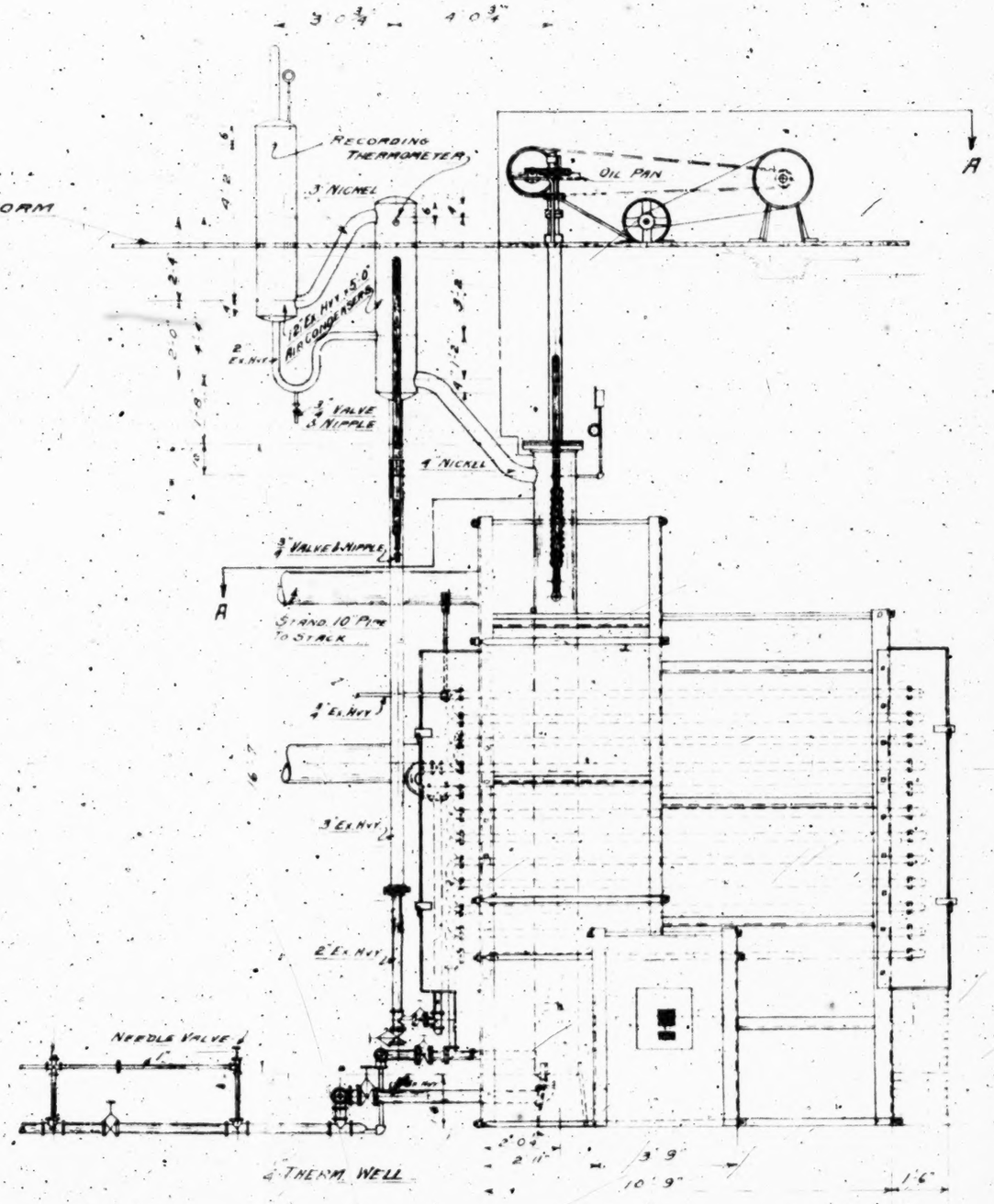
Otto Behimer.

OB-BAD 4-26-19

RCH (NY)-FTM (HO)-FTM (PA)

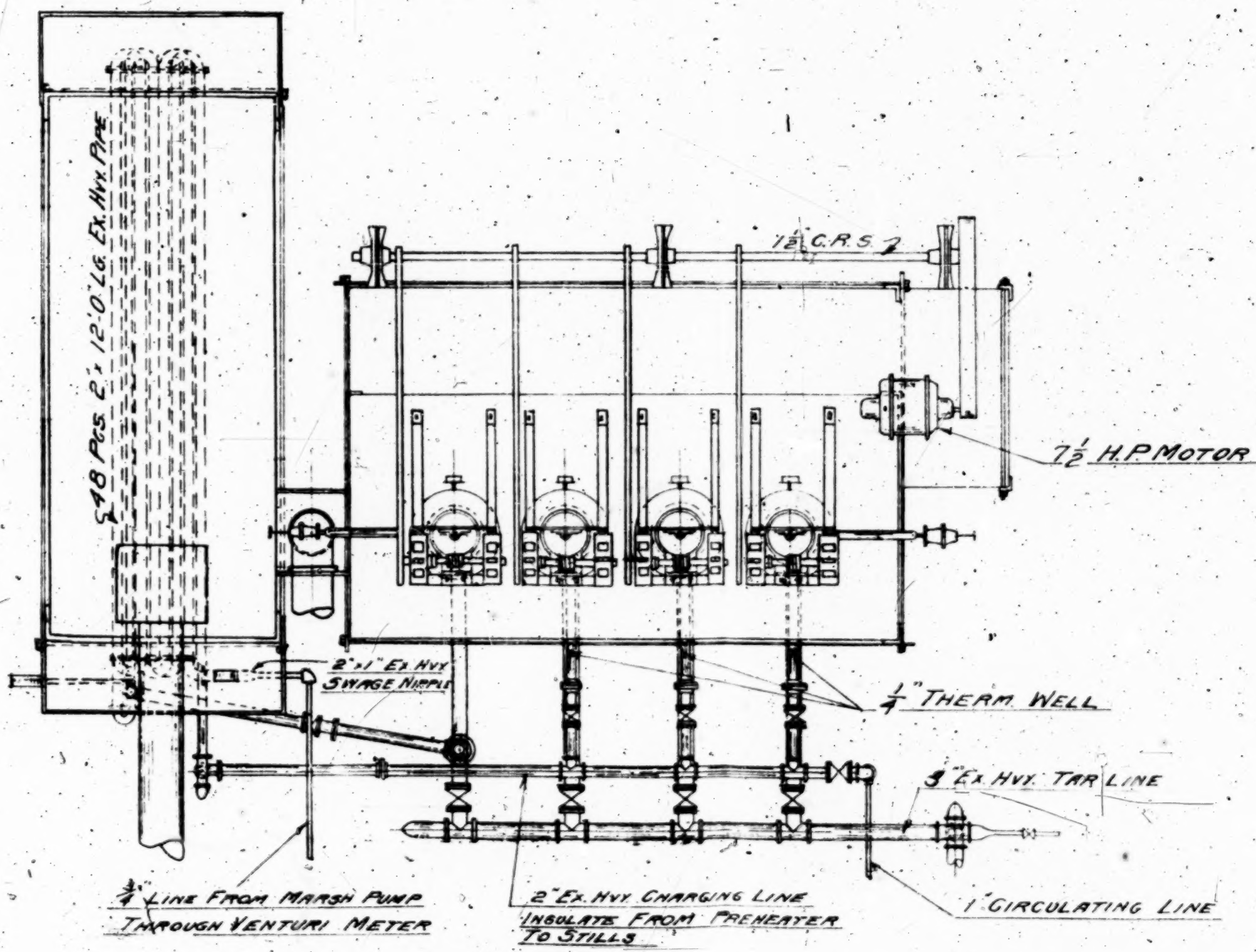


LEFT ELEVATION



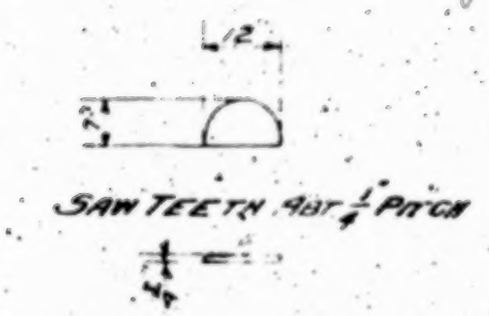
FRONT ELEVATION

LEFT ELEVATION

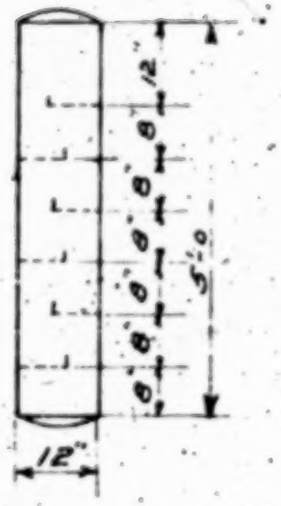


PLAN AT "A-A"

FRONT ELEVATION



DETAIL OF BAFFLE



DETAIL OF 12" x 5'-0" AIR CONDENSER

NOTICE

THIS DRAWING IS
PROPERTY OF THE T.
COMPANY ... IS NOT TO
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OF COMPANY ... DIRECT
OR THROUGH ... AGENT

THE TEXAS COMPANY

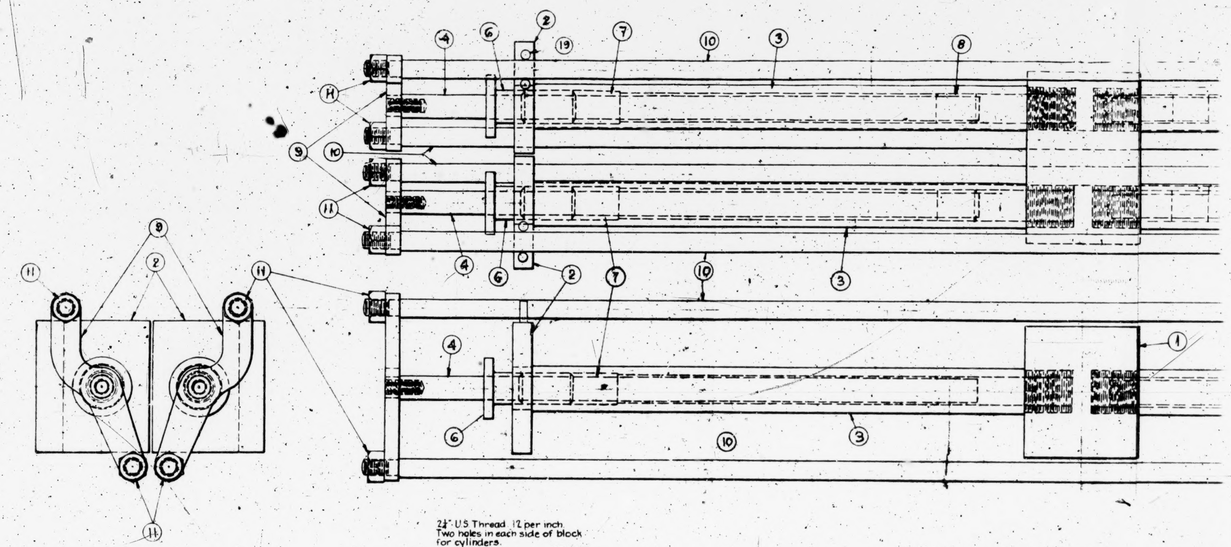
REFINING DEPARTMENT
PORT ARTHUR WORKS

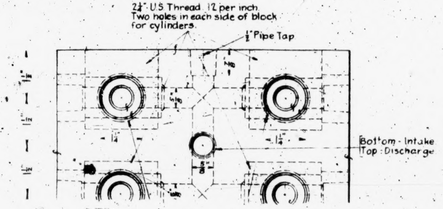
HIGH PRESSURE EXPERIMENTAL STILLS
GENERAL ARRANGEMENT OF STILLS
PREHEATER AND ECONOMIZER

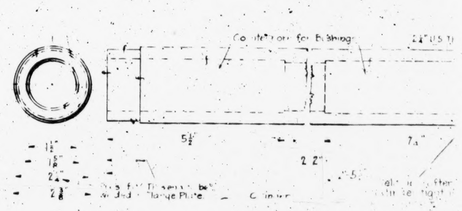
EXP 11-B EST. NO.

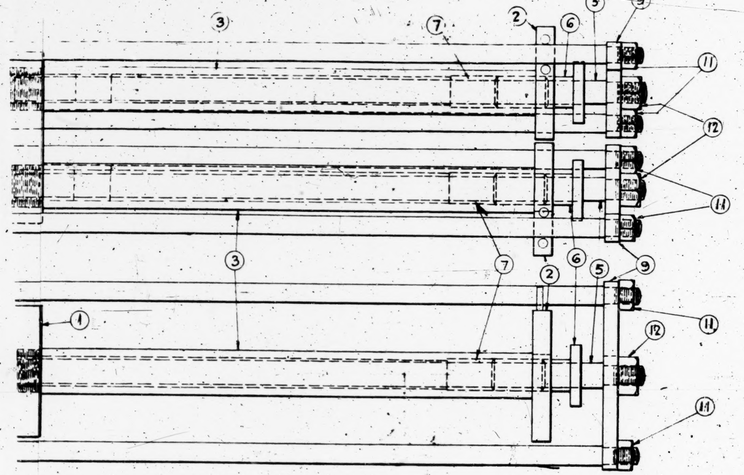
SCALE: 1/4" = 1'-0" DATE: 4-15-20 REVISED:

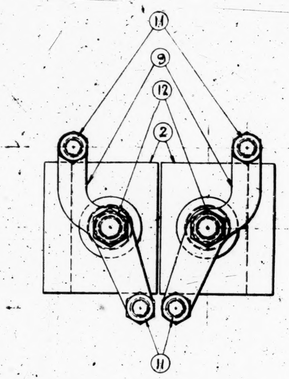
Drawn by J.E.B.	SUPPLEMENTAL NO.		PRINT NO.	Y-3
Traced by E.L.C.	X-3535-A	Y-3610 A	183691	
Checked by W.	X-3624 A			

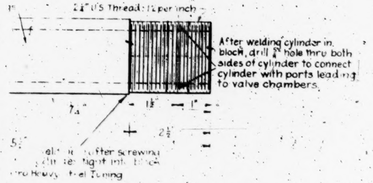


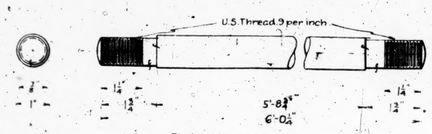




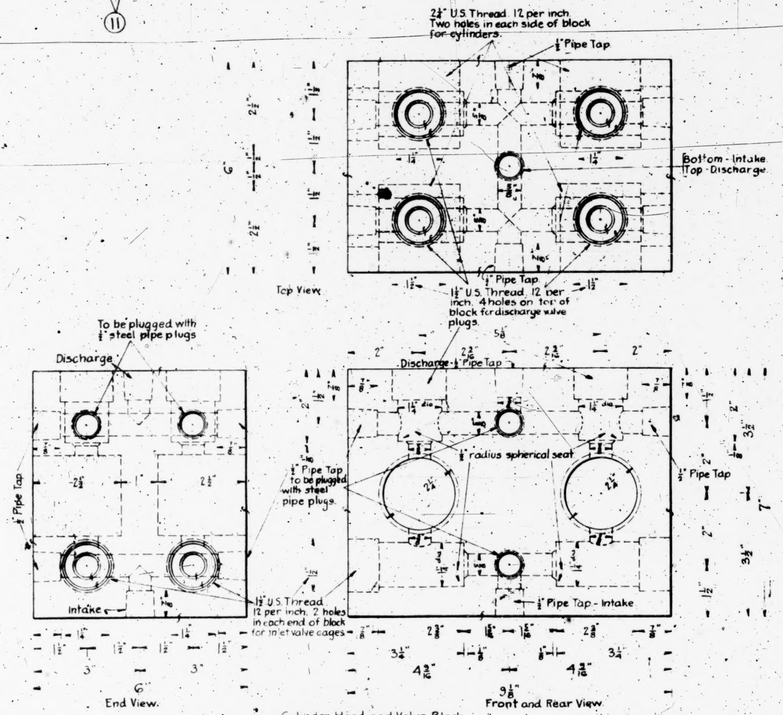




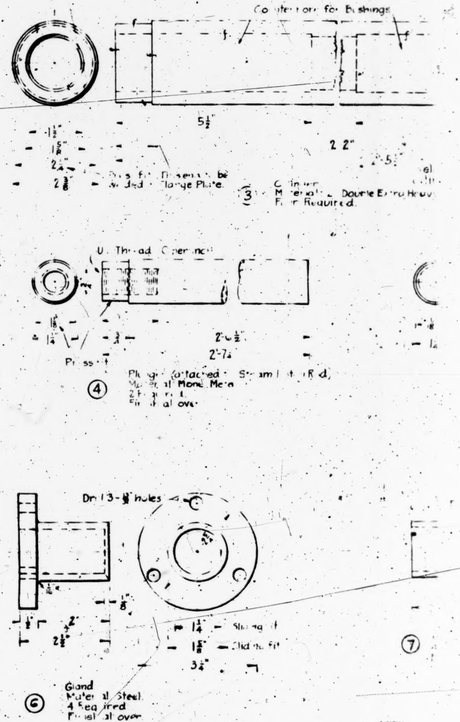


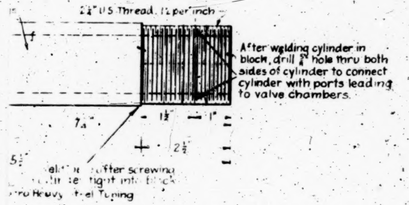


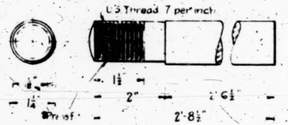
⑩ Plunger Yoke Tie Rod
Material 1" ϕ Rod
4 Required

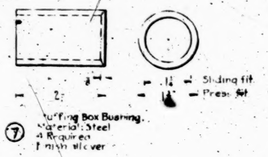


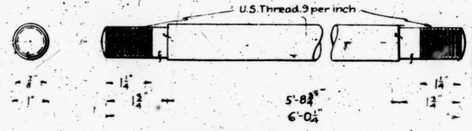
① Cylinder Head and Valve Block. Material: Steel Forging. 1 Required. Finish all over.

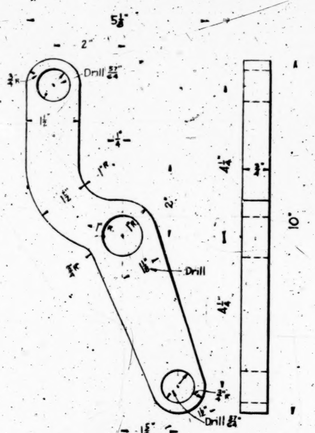






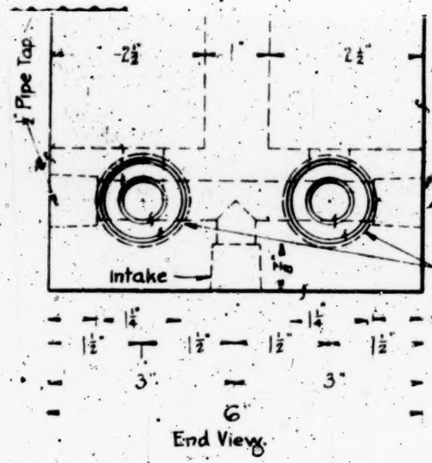


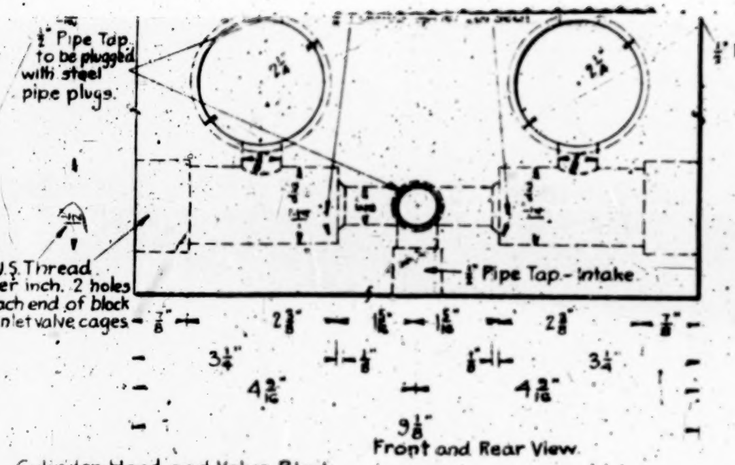


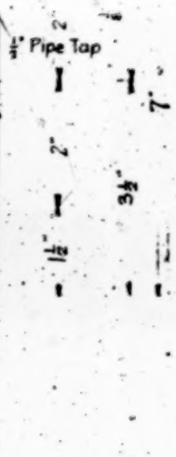


BILL OF MATERIAL

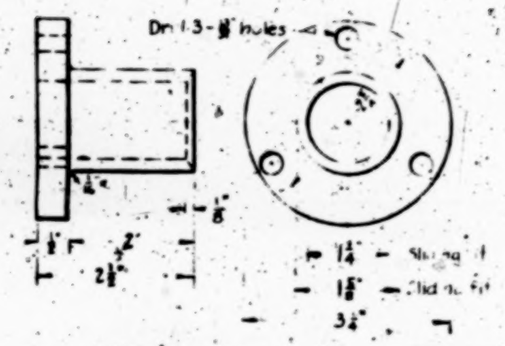
Mark	Description	Material	No Req
1	Cylinder Head and Valve Block	Steel Forging	1
2	Flange Plates	⅛ Steel Plate	4
3	Cylinders	2" D.E.H. Steel Pipe	4
4	Plungers - inner end	Monel Metal	2
5	Plungers - outer end	Monel Metal	2
6	Glands	Steel	4
7	Stuffing Box Bushings	Steel	4
8	Cylinder Bushings	Steel	4
9	Plunger Yokes	Steel Forging	4
10	Plunger Yoke Tie Rods	1" ϕ Rod	4
11	Plunger Tie Rod Nuts	1" Hex nuts	8
12	Plunger Yoke Nuts	1⅛ Hex nuts	2
13	Gland Studs	⅜-16 Thd. 2¾ long	12
14	Gland Stud Nuts	⅜" Hex	12
15	Valves	¾" dia. Steel Balls	8
16	Intake Valve Cages	Steel	4
17	Discharge Valve Plugs	Steel	4
18	Port Plugs	¼" Steel Pipe Plugs	8
19	Tie Rod guides	1" ϕ Rod	8
20	Washers for Steam Piston Rods	2" Plate Washers	2



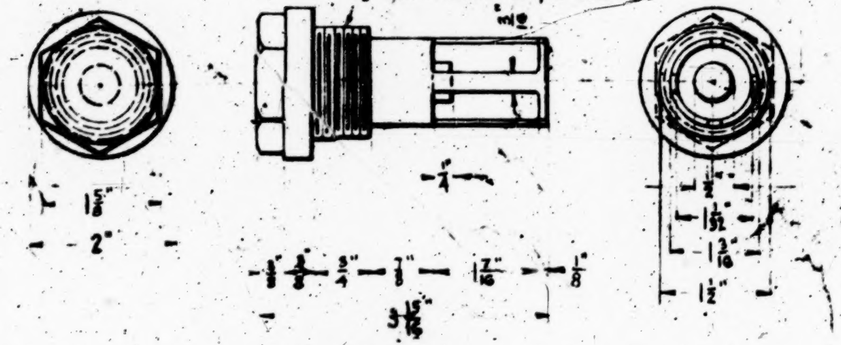




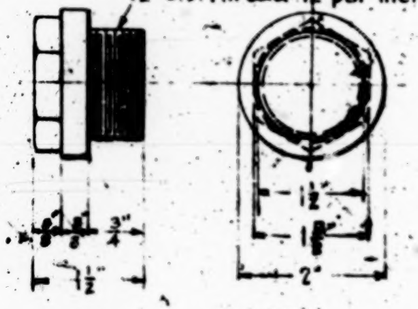
(1) Cylinder Head and Valve Block.
Material: Steel Forging.
1 Required.
Finish all over.



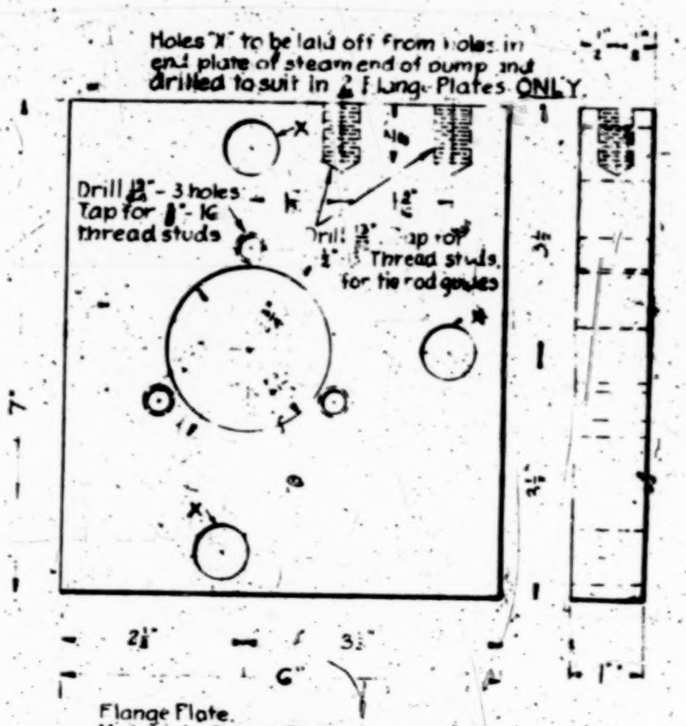
(6) Gland
Material Steel
4 Required
Finish all over



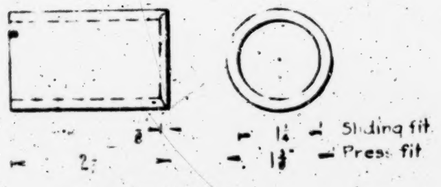
(16) Inlet Valve Cage.
Material: C.R. Steel.
4 Required.
Finish all over.



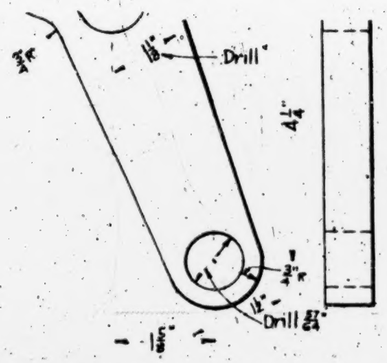
(17) Discharge Valve Plug.
Material C.R. Steel.
4 Required.
Finish all over.



(2) Flange Plate.
Material 1½ Steel Plate.
4 Required 2 with holes "X" 2 without
Outer face of each plate to be faced off after cylinder head block, cylinders and flange plates have been assembled and welded



⑦ Stuffing Box Bushing.
Material: Steel
4 Required
Finish all over

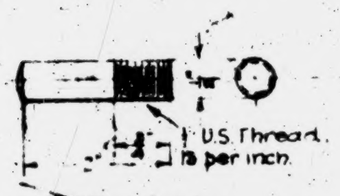


⑨ Plunger Yoke.
Material: Steel Forging
4 Required
Finish all over.

15	Valves.	1" dia. Steel Balls	8
16	Intake Valve Cages.	Steel.	4
17.	Discharge Valve Plugs.	Steel.	4
18	Port Plugs.	½" Steel Pipe Plugs.	8
19	Tie Rod guides	½" ϕ Rod	8
20	Washers for Steam Piston Rods	½" Plate Washers	2

⑧ Cylinder Bushing
Material: Steel.
4 Required.
Finish all over.

⑮ Valve.
1" Steel Ball.
8 Required.
Finish all over.



⑲ Tie Rod Guides.
Material ½" ϕ Rod.
8 Required.

EST. 2000 EXP. H-B

THE TEXAS COMPANY

REFINING DEPARTMENT
PORT ARTHUR WORKS

EXPERIMENTAL LABORATORY

HOT OIL PUMP FOR BACK TRAP FOR EXPERIMENTAL STILL.

SCALE: 3" & 6" = 1'-0" DATE: 3-4-21 REVISED:

Drawn By W.B.H.
Traced By W.B.H.
Checked By

SUPPLEMENTAL NO.

PRINT NO. 128583

Z-4346.

4603 DX 724.

(Letterhead of Dow Pump and Diesel Engine Co., Alemeda, Calif.)

(Stamp) Received The Texas Company Mar 28, 1921 Port Neches Works.

(In right-hand margin) Mr. Manley: Are you familiar with this or do you think it may have advantages over pumps we now use? C. Cort.

Alemeda, Calif., March 28, 1921.

Pumping Oil at 800 Degrees Fahr.

The Texas Company,
Port Neches,
Texas.

Attn. Refinery Engineer:

Gentlemen:

Has this problem ever come up for your solution—the transferring of oil, asphaltum or tar from stills to tanks at temperatures from 400 to 800 degrees Fahr.

The efforts of refiners today in obtaining a greater percentage of gasoline from crude oil has in many instances been blocked by their inability to secure suitable pumping equipment for the handling of liquids at very high temperatures. Various makeshifts have been resorted to, but, in all instances, great difficulty has been encountered due to the inability of any type of shaft or rod packing to withstand high temperatures.

The Thompson Patent Hot Oil Pump built exclusively by the Dow Pump and Diesel Engine Co. has met with all the requirements of this particular service and is made in a variety of sizes. The enclosed sketch No. 6506 shows the general arrangement.

The Shell Co. of Calif. and its affiliations have purchased and installed over forty of these pumps. The first pumps purchased by this company were put in operation in January, 1917, and since then have operated continuously 24 hours per day under a temperature of 750 degrees Fahr.

Due to the special construction of the fluid end of these pumps, however, the temperatures coming in contact with rod and piston packing has never exceeded 300 degrees. In all cases the pumps are handling oils between 700 and 800 degrees and in one instance asphaltum of approximately 700 degrees Fahr. is being transferred from asphaltum stills to storage tanks.

It was not until these pumps had passed far beyond the experimental stage and had demonstrated by years of successful service their ability to withstand high temperatures that we have placed them before the general public.

4604 If, in the operation of your plant, equipment of the type described above is required, we will be very pleased to go into the matter in detail and quote on whatever sizes you may require.

We also manufacture a complete line of Refinery and Pipe Line Pumps.

Your copy of our General Catalogue describing our pumping equipment is awaiting your instructions to mail.

Yours very truly,

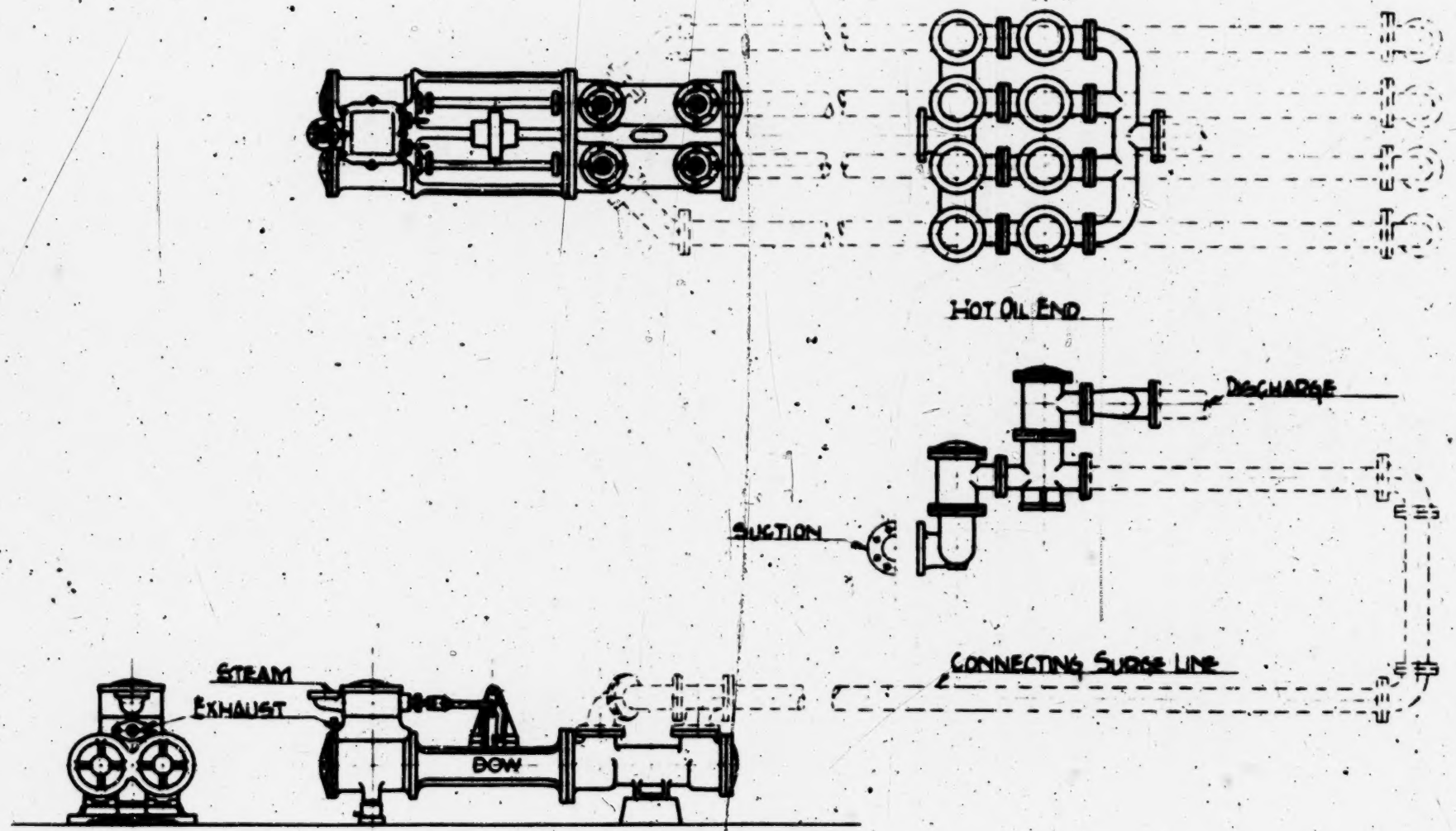
Dow Pump and Diesel Engine Co.,

By Robt. J. Tupper,

Sales Engineer.

Enc.

RJT:ALT



SKETCH # 6506

SPECIAL HOT OIL PUMP
(THOMPSON PATENT)
MANUFACTURED SOLELY BY
DOW PUMP & DIESEL ENGINE CO
ALAMEDA · CALIF.

2711

4606 DX 725.

Notegram.

Notegrams should be used for brief general inter-office and inter-department correspondence. Plain and abbreviated language only should be used and all letter formalities be omitted.

Subject.

Port Arthur, Texas, April 9, 1921.

Dow Pump and Diesel Engine Company Pumping Oil at 800 Degrees Fhr.

Mr. Capen:

This is just what I am looking for. We intend trying the idea out in connection with the Worthington Pump. It is too simple to be true.

I had 2 blue prints made for Laboratory file.

Otto Behimer.

M.

4607 DX 726.

Notegram.

Notegrams should be used for brief general inter-office and inter-department correspondence. Plain and abbreviated language only should be used and all letter formalities be omitted.

Subject.

Port Arthur Works
April 8, 1921.

Mr. Elliott:

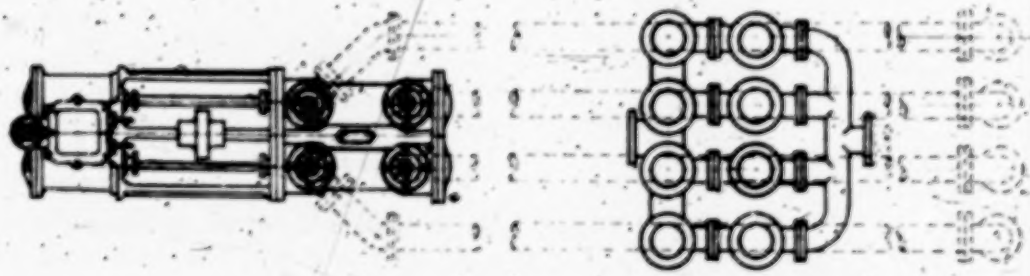
Please make up a couple blue prints of attached as soon as possible.

Otto Behimer.

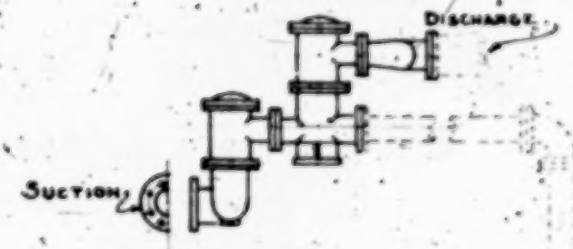
M.

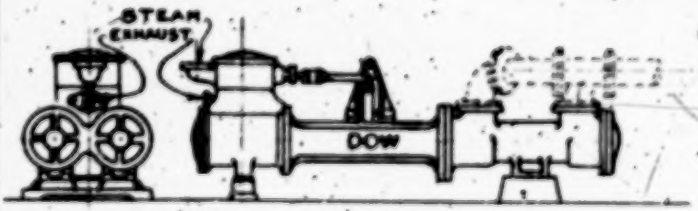
Attached
WHE

1 copy to Donaldson
4/9/21



HOT OIL END.





CONNECTING SURGE LINE.

THE TEXAS COMPANY
REFINING DEPARTMENT
PORT ARTHUR WORKS

PUMPS
HOT OIL PUMP
(THOMPSON PATENT.)

SCALE none. DATE 4/8/27 REVISED

T
4515.

4609 DX 727.

Notegram.

Notegrams should be used for brief general inter-office and inter-department correspondence. Plain and abbreviated language only should be used and all letter formalities be omitted.

Subject.

Port Arthur Works
May 3, 1921.

Pumps.

Mr. Dodge:

This is no doubt by far the best scheme suggested up to present time for handling the back trap or hot residuums, and is being made up with slight modification to be installed on Battery No. 14 between heavy air condenser and pre-heater inlet.

Otto Behimer.

OB-MM

4610 Dow Pump and Diesel Engine Company.

Alameda, Calif. March 23, 1921.

Pumping Oil at 800 Degrees Fahr.

The Texas Co.,
Port Arthur, Texas.

Attention Refinery Engineer:

Gentlemen:

Has this problem ever come up for your solution—the transferring of oil, asphaltum or tar from stills to tanks at temperatures from 400 to 800 degrees Fahr.

The efforts of refiners today in obtaining a greater percentage of gasoline from crude oil has in many instances been blocked by their inability to secure suitable pumping equipment for the handling of liquids at very high temperatures. Various makeshifts have been resorted to, but in all instances, great difficulty has been encountered, due

to the inability of any type of shaft or rod packing to withstand high temperatures.

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We also manufacture a complete line of Refinery Pipe Line Pumps.

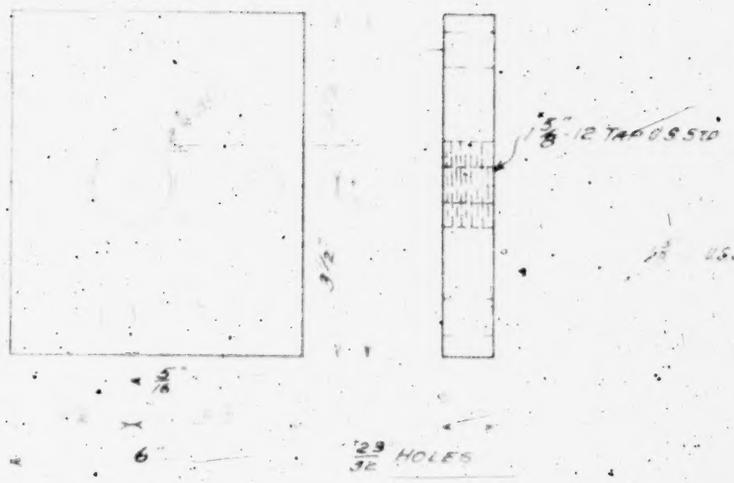
Your copy of our General Catalogue describing our pumping equipment is awaiting your instructions to mail.

Dow Pump and Diesel Engine Company,
By Robert J. Tupper,
Sale Engineer.

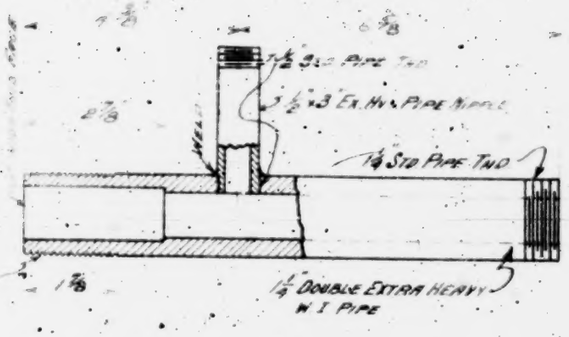
Enc.
RJT:ALT

2719

DX 198



FLANGE PLATE
1-REQD STEEL-AS SHOWN-A-1



OIL CYLINDER
2-REQD-W.I. PIPE-A-3

SHAFT COUPLING
2-REQD-STEEL-A-6

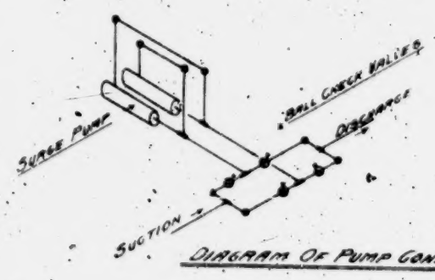
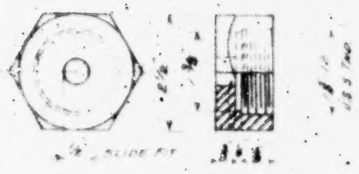
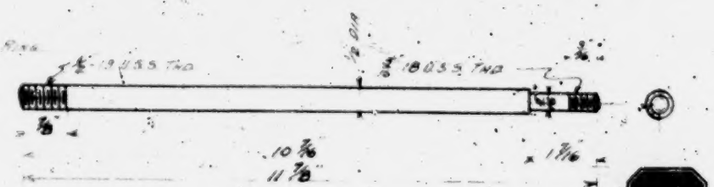


DIAGRAM OF PUMP CONNECTION

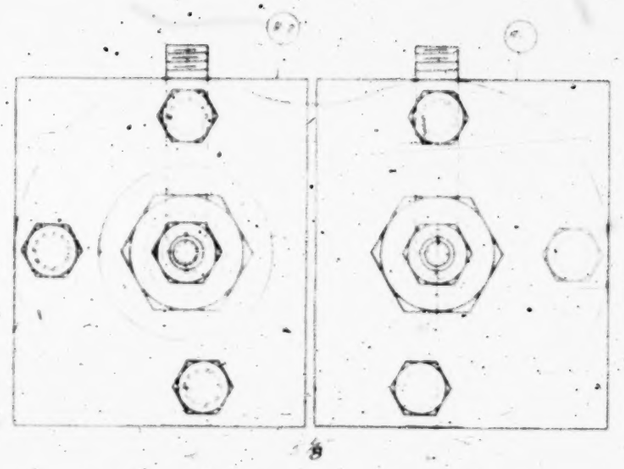


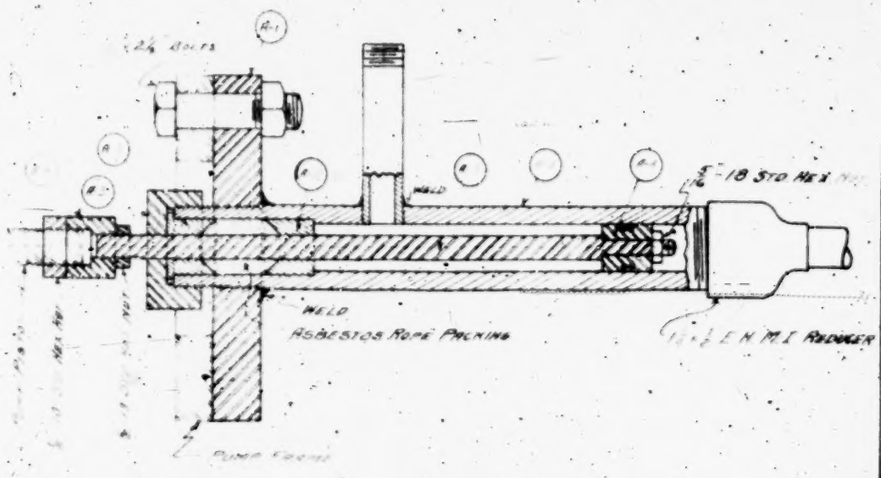
GLAND
2-REQD-BRONZE-A-7

PISTON & RING
2-REQD-STEEL-A-4



PISTON ROD
2-REQD-C.R. STEEL-A-5





NOTE:
THIS PUMP TO BE ATTACHED TO NORTHINGTON 10"×12"×9 DUPLEX STEAM PUMP

THE TEXAS COMPANY
REFINING DEPARTMENT
PORT ARTHUR WORKS

RESEARCH LABORATORY
DETAILS OF SURGE PUMP

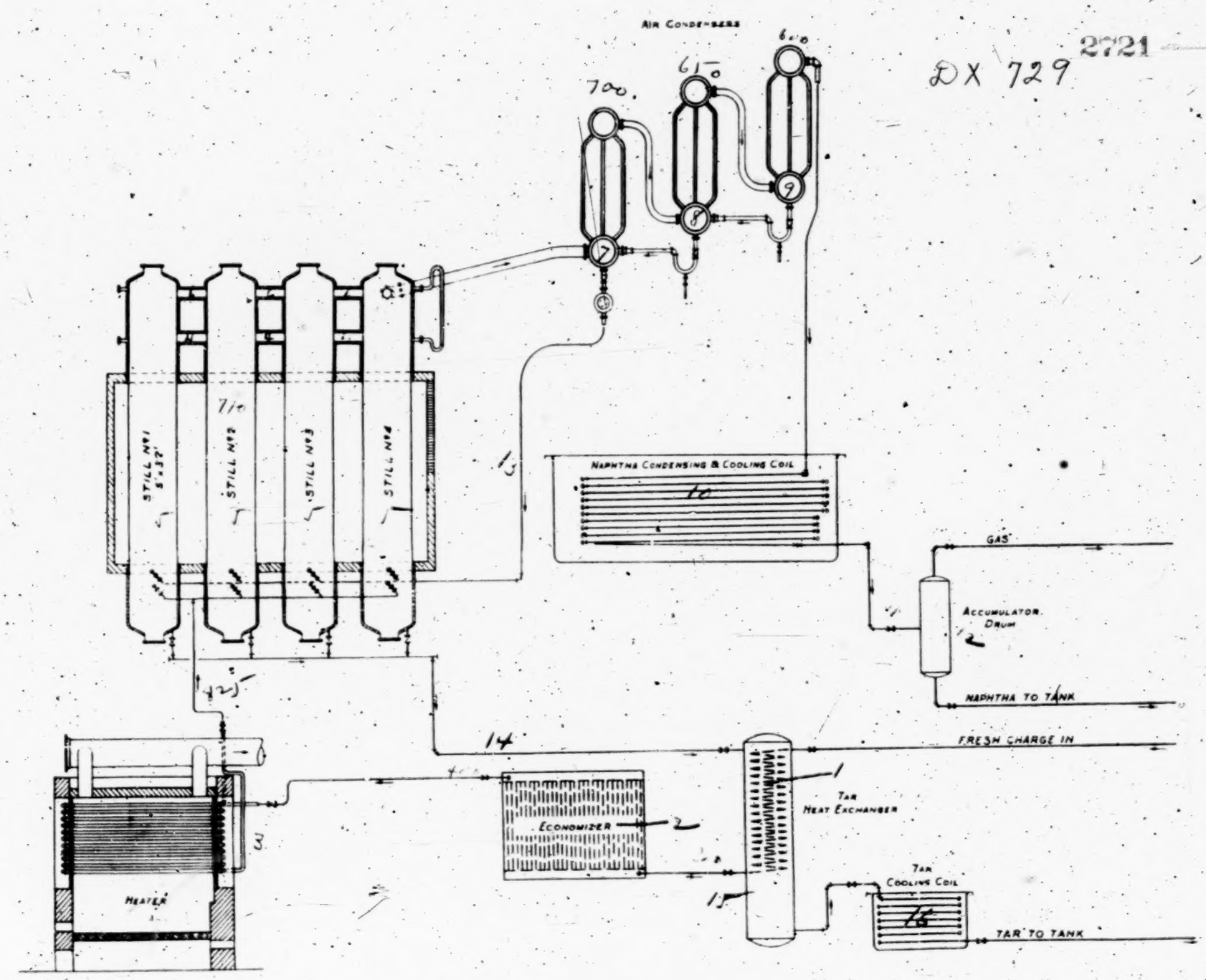
EXP. 11-B EST. 2000

SCALE 6"=1'-0" DATE: 5-28-21 REVISED:

Drawn by E.L.C. Traced by E.L.C. Checked By

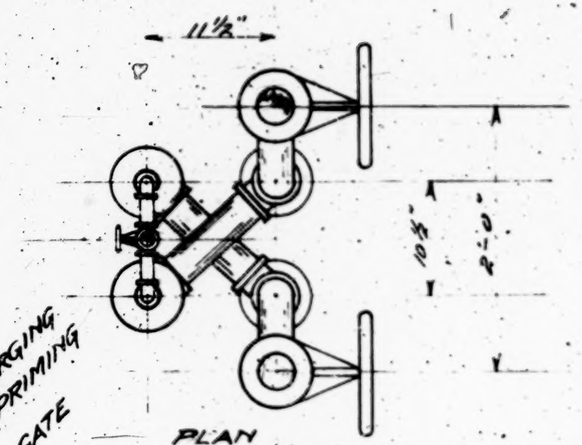
SUPPLEMENTAL NO. PRINT NO. 1857 X-4644

DX 729 2721

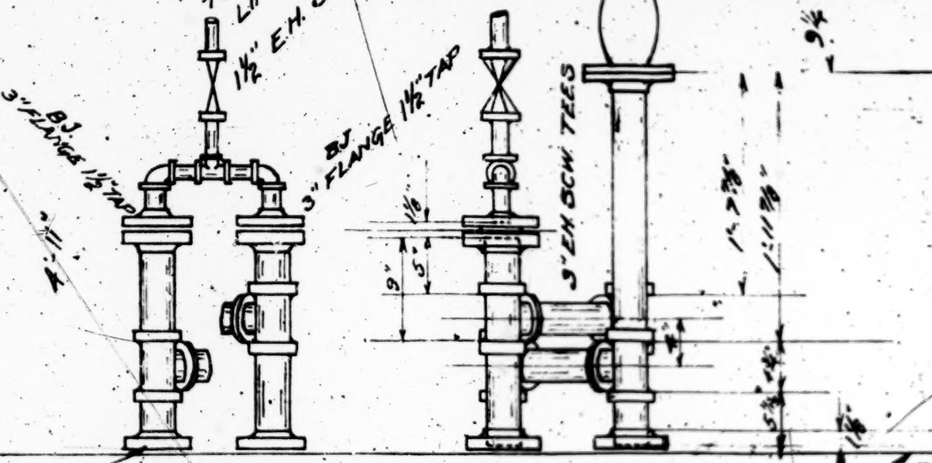


FLOW DIAGRAM
OF
ORIGINAL COMMERCIAL BATTERIES
OF THE TEXAS CO.

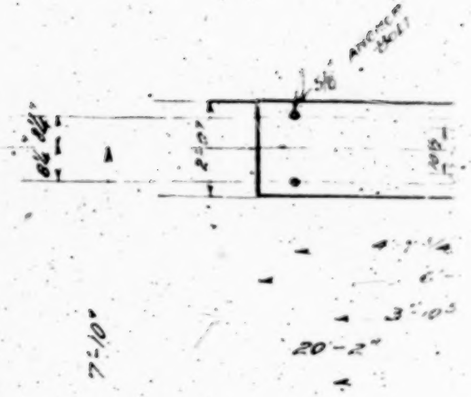
IN THE DISTRICT COURT
OF ILLINOIS

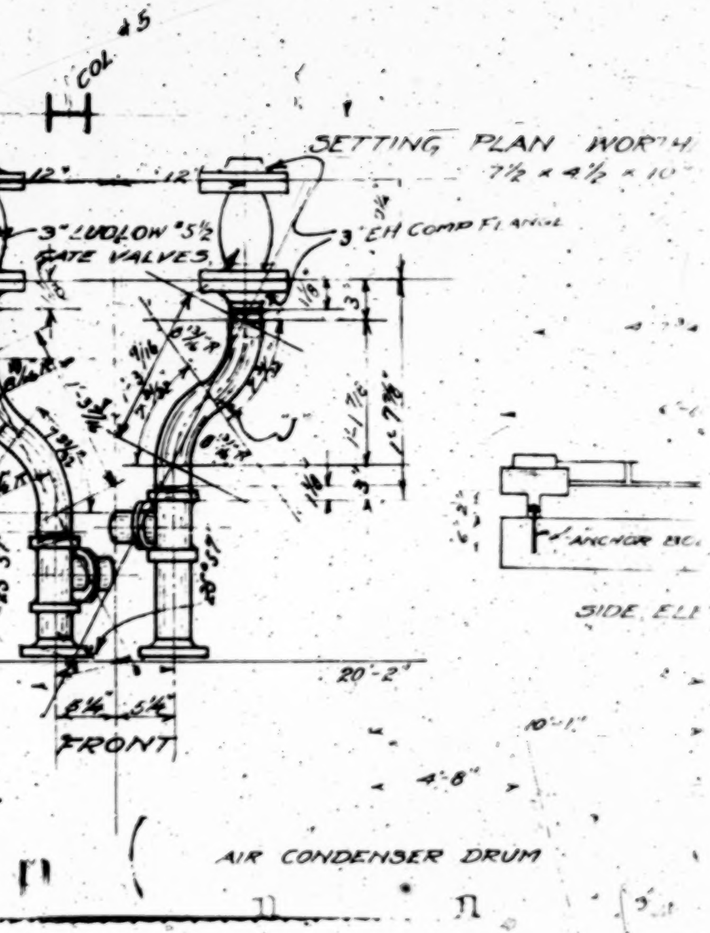


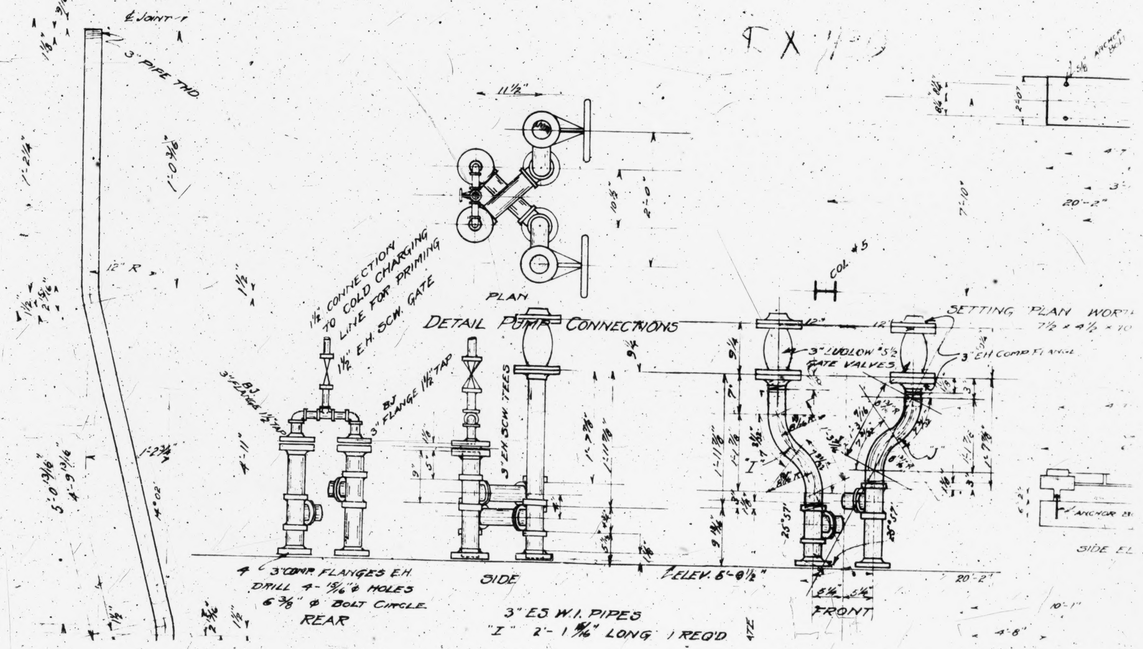
DETAIL PUMP CONNECTIONS



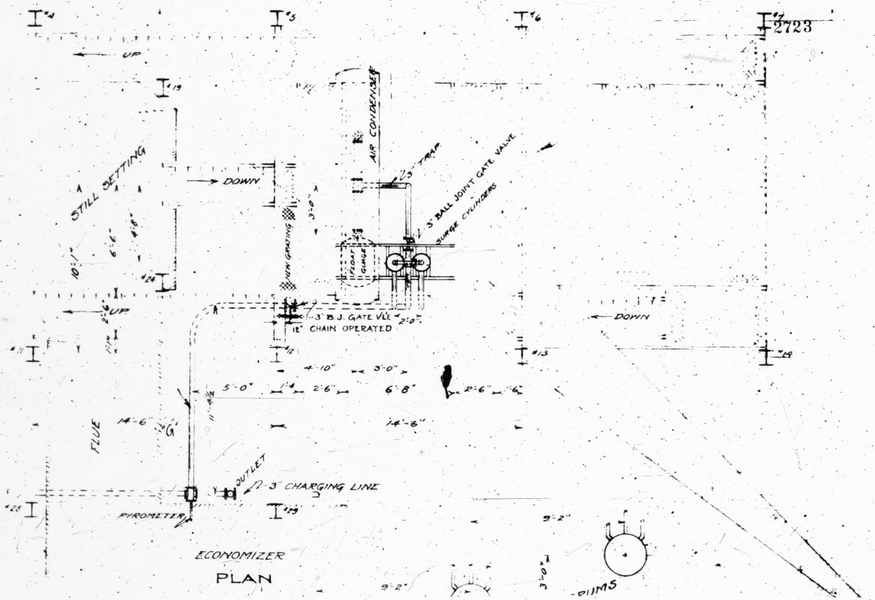
3" E3 W.I. PIPES
"I" 2'-1 15/16" LONG 1 REQ'D.
"J" 1'-11 5/16" " "

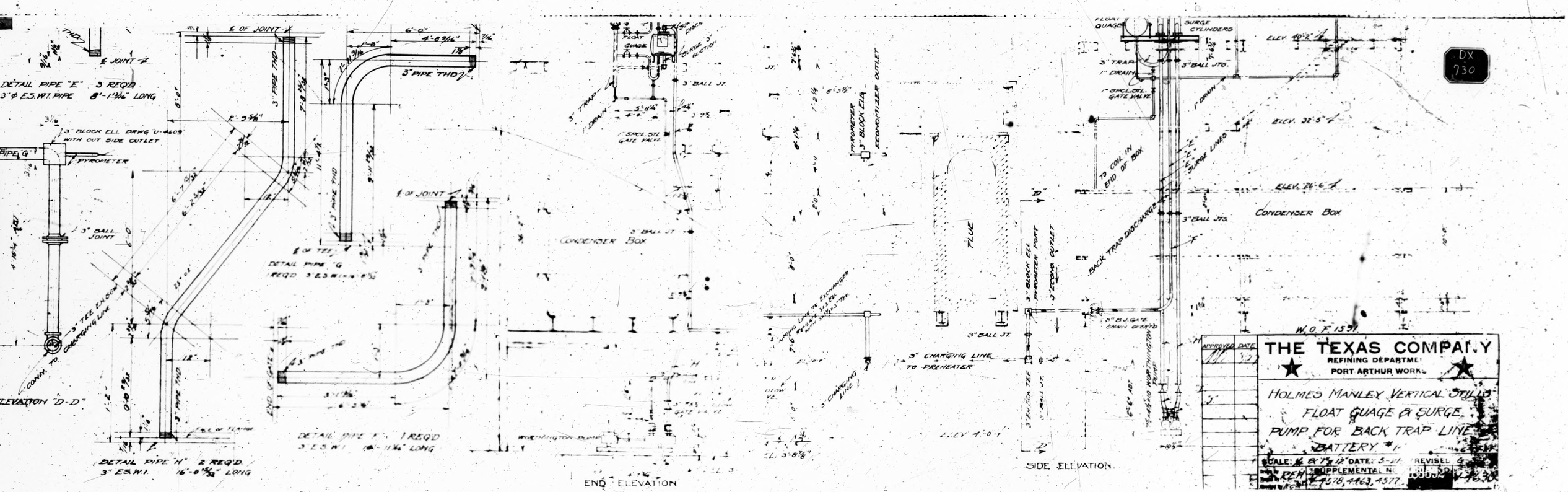




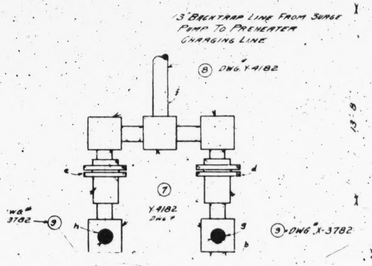

Detail Pump Connections
PLAN
SIDE
REAR
FRONT
3" E.S. W.I. PIPES
"I" 2'-1 7/16" LONG 1 REQ'D
3" E.H. SCH. TEES
3" HOLLOW STEM GATE VALVES
3" E.H. COMP'N FLANGE
3" FLANGE 1½" TAP
1½" CONNECTION TO COLD CHARGING LINE FOR PRIMING
1½" E.H. SCH. GATE
3" PIPE THD
ELEV. 6'-0½"
ELEV. 5'-0 9/16"

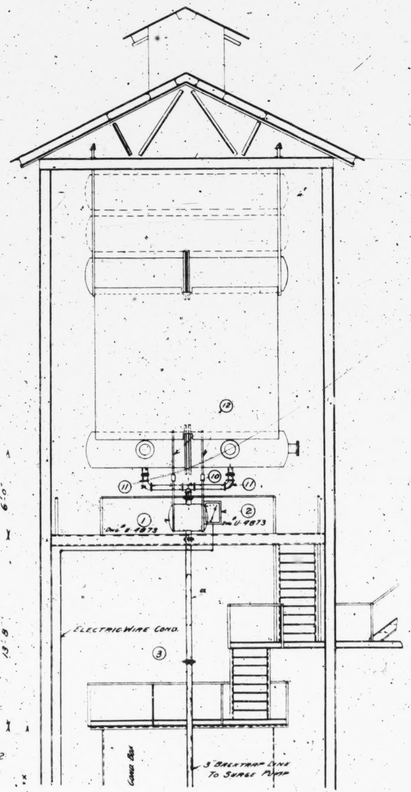
WORTHINGTON PUMP
VALVES REMOVED
SIDE ELEVATION
ELEV. 3'-8⅞"

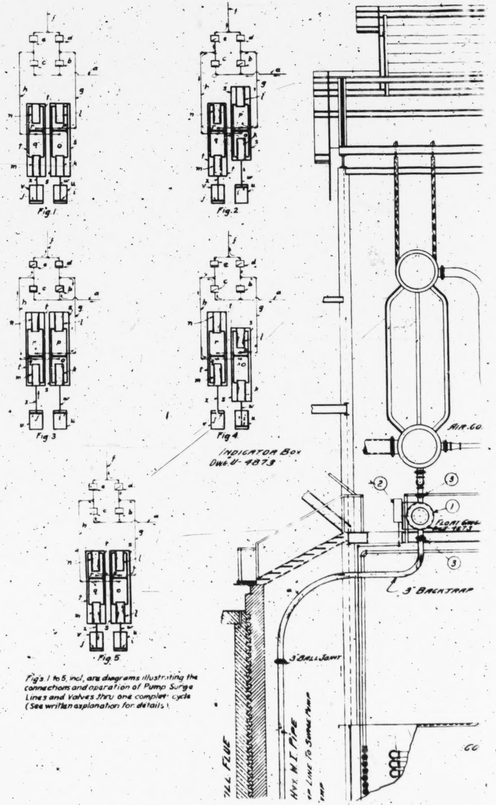

ECONOMIZER
PLAN
STILL SETTING
AIR CONDENSER
3" TRAP
3" BALL JOINT GATE VALVE
STEEL CYLINDERS
3" B.J. GATE VLV.
12" CHAIN OPERATED
3" CHARGING LINE
OUTLET
PYROMETER
FLUE
UP
DOWN


DETAIL PIPE "E" 3 REQ'D
3" ϕ E.S.W.T. PIPE 8'-1 3/16" LONG
3" BLOCK ELL DRWG "U-4603" WITH OUT SIDE OUTLET
PYROMETER
3" BALL JOINT
3" TEE END ON CHARGING LINE
CONN. TO
ELEVATION "D-D"
DETAIL PIPE "H" 2 REQ'D
3" E.S.W.I. 16'-0 5/16" LONG
DETAIL PIPE "G"
REQ'D 3 E.S.W.I.
3" PIPE THD
E OF JOINT
E OF TEE
E OF GATE
DETAIL PIPE "F" 1 REQ'D
3 E.S.W.I.
FLOAT GUAGE
SURGE 3" SUCTION
3" BALL JT.
3" TRAP
DRAIN
3" SPCL. STL. GATE VALVE
CONDENSER BOX
MACHINE TOOL BASE
END ELEVATION
3" BLOCK ELL
PYROMETER
ECONOMIZER OUTLET
3" CHARGING LINE TO PREHEATER
FLUE
3" TEE ON OUTLET
3" BALL JT.
ELEV. 4'-0"
SIDE ELEVATION
FLOAT GUAGE
SURGE CYLINDERS
ELEV. 40'-2"
3" TRAP
1" DRAIN
1" SPCL. COIL GATE VALVE
3" BALL JTS.
ELEV. 32'-5"
SURGE LINES
TO COIL IN END OF BOX
ELEV. 26'-6"
CONDENSER BOX
BACK TRAP DISCHARGE
3" BALL JTS.
3" BUGGY CHAIN OVER TO
MACHINE TOOL BASE
DX 730
W. O. F. 1591
APPROVED
DATE
THE TEXAS COMPANY
REFINING DEPARTMENT
PORT ARTHUR WORKS
HOLMES MANLEY VERTICAL STILLS
FLOAT GUAGE & SURGE
PUMP FOR BACK TRAP LINE
BATTERY #1
SCALE: 1/4" & 1" 12" DATE: 5-21 REVISED
DRN. REN SUPPLEMENTAL NO.
4576, 4463, 4577.

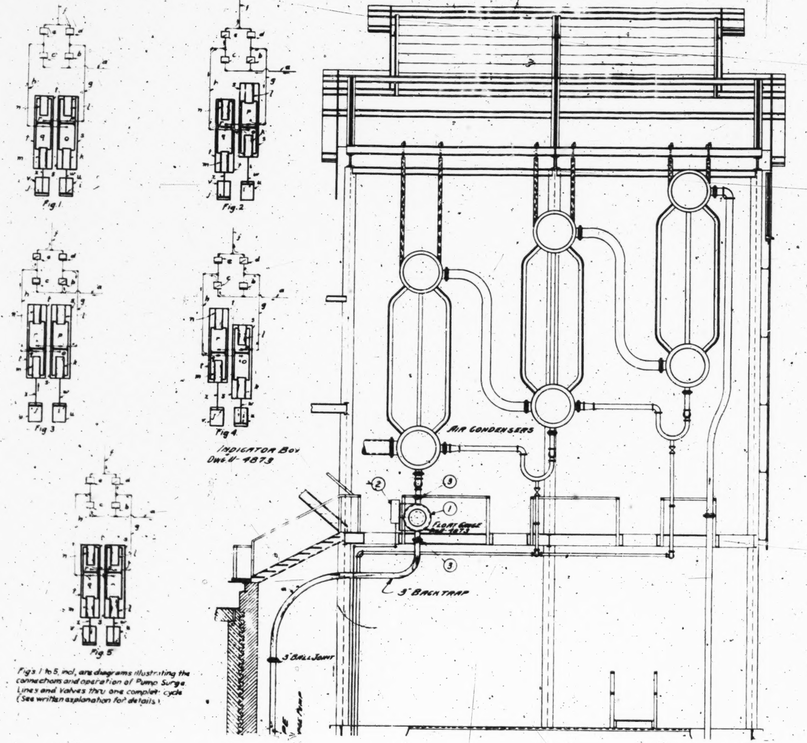
PX 7-1 2723







Figs 1 to 5, incl, are diagrams illustrating the connections and operation of Pump Surge Lines and Valves thru one complete cycle (See written explanation for details.)

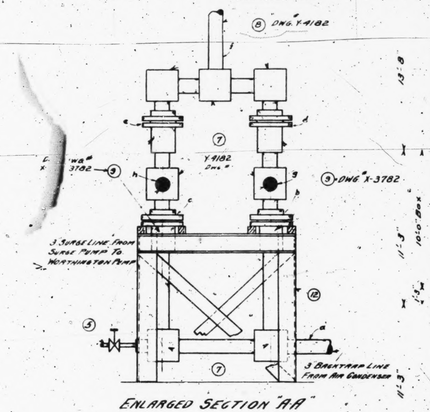


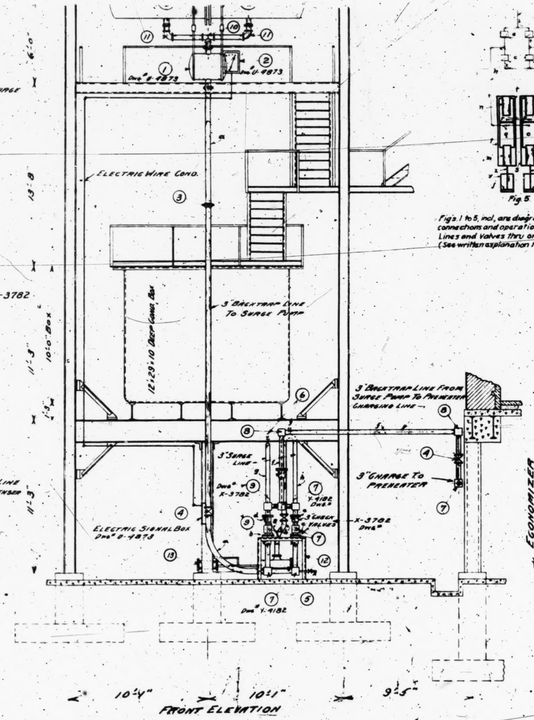
Figs 1 to 5, incl, are diagrams illustrating the connections and operation of Pump Surge Lines and Valves thru one complete cycle (See written explanation for details.)

LEGEND

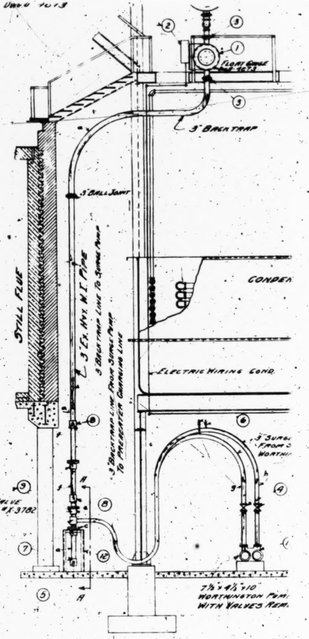
1	Float Gauge
2	Recorder Box
3	3" Ball Joint Cast Steel Flange
4	3" List 637E Chapman Gate Valve
5	1" Bleeder To Jar Line
6	1/2" Bleeder
7	3" Forged Steel Block Tee
8	" " " Ell.
9	" " Check Valve
10	4" x 4" x 3" Ateraite Tee
11	4" " " Ell
12	Supports
13	7 1/2" x 9 1/2" x 10" Worthington Pump With Valves Removed

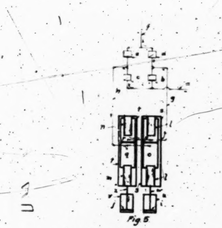
DX 731



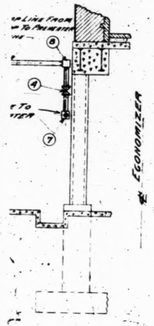


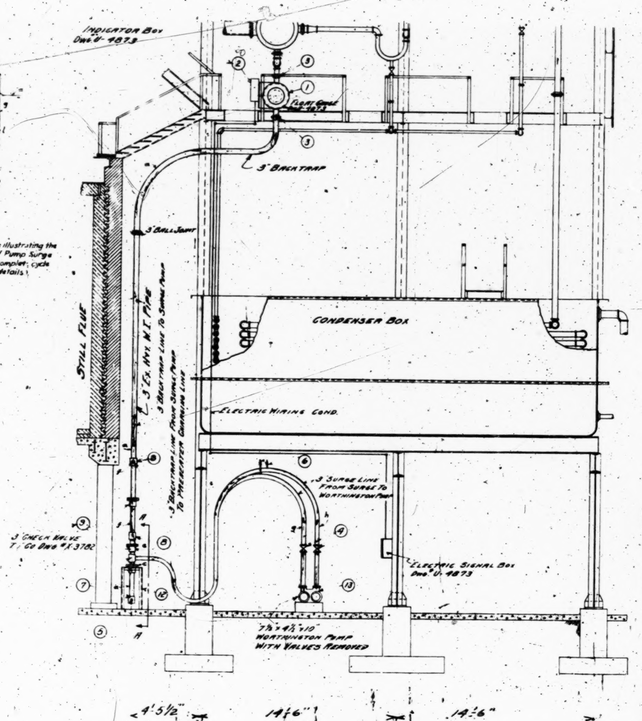
Figs. 1 to 5, incl, are diagrams illustrating the connections and operation of Pump Surge Lines and Valves thru one complete cycle (See written explanation for details).





Figs. 1 to 5, incl, are diagrams illustrating the connections and operation of Pump Surge Lines and Valves thru one complete cycle (See written explanation for details).





EX 331

NOTICE

THIS DRAWING IS THE PROPERTY OF THE TEXAS COMPANY. IT IS NOT TO BE TAKEN FROM THE WORKS OF THE COMPANY AND MUST BE RETURNED TO THE DRAFTING ROOM AS SOON AS IT HAS SERVED ITS PURPOSE.

ESTIMATE NO.

THE TEXAS COMPANY

REFINING DEPARTMENT

PORT ARTHUR WORKS

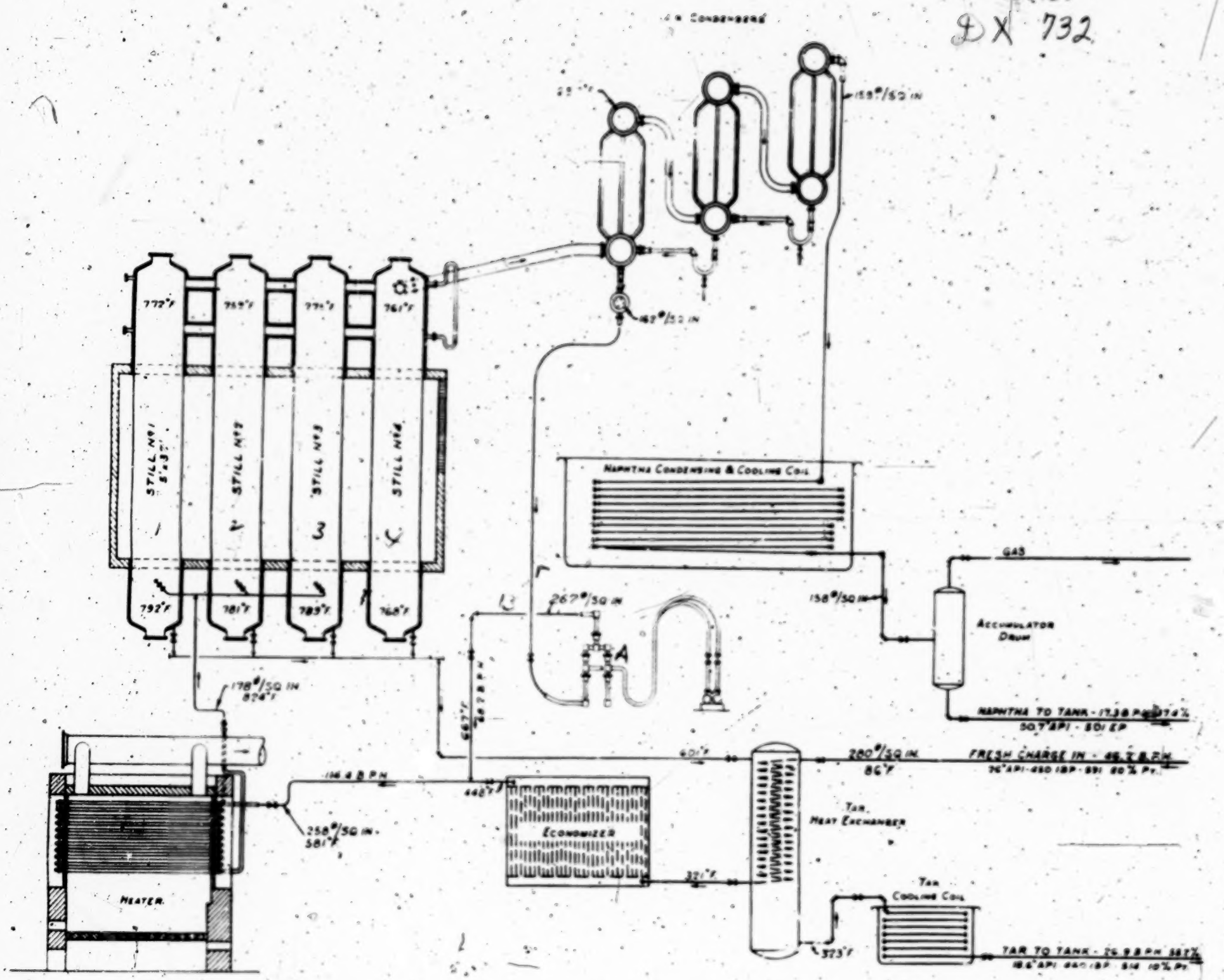
HOLMES-MANLEY VERTICAL STILLS

BAT'S 1-2

BACK TRAP SURGE PUMP LINE CONNECTIONS

SCALE: 1/4"=1'-0"	DATE: 10-21	REVISED:
Drawn E.L.S.	SUPPLEMENTAL NO.	PRINT NO.
Traced E.L.S.	4873	183607 Y-1831
Checked	3/4"=1'-0"	

2227
DX 732



FLOW DIAGRAM
OF
COMMERCIAL BATTERY 14
BEHIMER PROCESS
RUN 63

FIRES - LITED 10-3-21 FIRES C.T 1-21

TRACING RECORD

PORT ARTHUR WORKS

PAGE

NUMBER	DATE	TITLE	SCALE	SIZE	REVISED
1-10A	10/5/10	Layout of Limestone [illegible]			1-29-12
10?		W-S Cake Still [illegible]	None	11X17	
702	12/6/11	Steel Details Alterations to			
170	12/6/11	Steel Still Shed Exp Lab Est 2000	None	11X17	
		E. Pump C. Settling Plant			
		Ex addition to Equip Lub Oil			
		Treating Plant Est 1640	1-20	11X17	
		[illegible]			
		[illegible] for Sulphuric Acid Still	None	11X17	
					24 17

6626

4618

DX 734.

[This exhibit was offered and is included in the appeal record under the provisions of Rule 43(c).]

4619

Otto Beheimer.

The following statement was dictated by Mr. Beheimer on May 10, 11 and 12, 1926 at Port Arthur, Texas, in the presence of D. M. Mace, W. T. Donaldson and J. S. McCarthy. It briefly outlines his present recollection of the experimental work carried on by the Texas Company at Port Arthur during the years 1916, ~~and~~ 1917, (AND 1918) particularly in reference to the oil cracking processes now commonly known as "Clean Circulation" and "No Decomposition in the Coil".

I worked for the Cross Brothers at Kansas City and was familiar with their patented system before I came to the Texas Company in October, 1915. This was a heat treating process, the apparatus consisting of a coil and drum in which they circulated the oil from the drum to the coil or preheater until it reached a certain pressure which completed the digestion period. Even at that time I considered it a poor arrangement to circulate the residum through the coil.

While working for Cross I carried on several experiments on different oils, utilizing a small bomb in which the oil was brought up to a high temperature under a high pressure. While working for Cross I became acquainted with Dr. Gray who was then associated with the Texas Company and through him obtained a position with the Company.

I entered the service of the Texas Company at Port Arthur, Texas, on October 25, 1915 and started to duplicate my Cross experiments, using different grades of
4620 oil in order to determine the yields obtainable and the rates of decomposition; also to observe the character of the distillate produced under pressure as com-

pared with the distillate produced in a heat-treating process.

In conducting these experiments I at first used a small bomb and about January, 1916, I started experimenting on a apparatus modeled after the *4 Redwood patent. I believe Dr. Gray outlined the experiments on all this apparatus before I came with the Company.

The first run on the Redwood apparatus was made with gas oil but this did not decompose very rapidly so they changed the stock. *5 Later the Redwood equipment was modified by lowering the brick work so as to cover the upper half of the still and also the air condenser was arranged vertically instead of horizontally. The chief result of this change was in the character of the product. The heat reaction was reduced from above 100 to about 50 or 60 degrees. Also on account of this change the accumulation of kerosene fractions was more noticeable than in the original Redwood design, especially on Rule 12 of this apparatus, and about this time came the conception of returning or backtrapping the kerosene accumulation to the front of the still, so that it would pass through the entire length of the heated still. 5

After the first experiments on the Redwood apparatus a few runs were made upon a coil, which runs demonstrated that the coil could not be operated for any length of time on account of carbonization in the tubes. This equipment was not designed by me but I was aware of its numerous defects before the apparatus was installed, 4621 and I suggested to the ~~Engineer~~ Keokeok at the time it was being built and also later, I believe, to Mr. Holmes and Mr. Manley, that the system could be greatly improved by adding a drum in order to utilize the heat of the oil to continue the decomposition in the drum, instead of running the heated oil directly from the coil outlet into a condenser coil. This equipment was abandoned because of mechanical inconveniences and the carbonizing of the coil.

About the time I noted the accumulation of kerosene fractions to the front of the still on Run #12 February 1916 of the Redwood apparatus, I was trying to work out a theory of how to make a practical operating equipment and drew up a sketch at the time, but I was not able to get a design or method that

* Italics are pencil notations in original.

looked feasible. This sketch consisted of a vertical drum connected, outside a furnace, to a heated 12 inch horizontal pipe, similar to the equipment of Experiment #6. There was a vapor outlet from the pipe to the drum, near the top, and a liquid connection near the bottom. From the top of the drum the vapors went to an air condenser where the heavy kerosene or backtrap fractions were separated from the nephtha and returned to the front of the pipe or still. The charge entered at the same point as the backtrap at the front of the still. This design was abandoned as not practical. No blue-print of this sketch was made, nor was anything further done along these lines because I came to the conclusion that the only practical way of preheating the backtrap would be to confine it in a coil, together with the charge so that it could be introduced into the bottom of a drum or still. The object was to
4622 get a volume of oil and at the same time maintain the temperature of the oil without subjecting it to the dangers of high furnace temperatures. It was known at that time that the tensile strength of iron would have to be considered in connection with high furnace temperatures and it was also known than an accumulation of carbon in the still would cause the still wall temperature to become the still furnace temperature when the still wall became coated with a thick coat of carbon. I also knew at that time caracking could not be carried on extensively for any length of time in a coil without carbonizing and burning of the tubes.

Now the problem was how to protect the coil and how to maintain the temperature in the drum without subjecting it to intensive furnace gases so the idea came of circulating the backtrap through the coil, together with the charge so as to increase the velocity in the tube to overcome carbonization and to carry such a temperature that it would not carbonize, utilizing the heat in both the backtrap and the charge for holding up the temperature in the drum and also the additional advantage of cutting of the cooling caused by the vaporization of the backtrap, if returned directly to the still.

At this time there were four problems to be solved:

1. How to construct a still to withstand high pressure and temperature;
2. How to build the coil;
3. How to force the backtrap to the coil, and

4. The design and construction of the complete apparatus to carry out my scheme.

It was not known to what extent the heat in the
4623 drum could be maintained by the charge and back-
trap heated in the coil. It was known that the temperature in the drum would be somewhat lowered but I hoped that the temperature in the drum would be high enough so that we would not have any outside heating.

The idea of this arrangement was turned over to a draftsman named Smith in the fall of 1916 and it was conceived by me sometime between the time it was turned over to Smith and the noting of the accumulation of kerosene fractions on Run 12 of the Redwood apparatus. To the best of my present recollection the date of the conception of this idea was about the first of August, 1916.

The scheme was presented to Smith simply as an engineering problem and I was rather disappointed at the time that the Engineering Department turned the matter over to such an inexperienced man. However, I explained the scheme to him and suggested that he work out some suitable means for positively returning the backtrap to the coil, and as a result he suggested the use of a jet pump. I was rather pleased with the idea because I knew that there was very little resistance through a 3 inch coil, which we intended to use and I also knew that asbestos packing would not stand the temperature of an ordinary pump. When Smith finally sent a drawing of the apparatus to me for approval I had him relocate the jet on the on the inlet of the charging coil and change the position of the condenser so as to make the equipment more compact and thus reduce radiation losses. I remem-
ber that Smith made these changes on the drawing
4624 on the drawing at my suggestion at the time and that
he returned with it to the drafting room for revision.

Soon after the suggestion of a jet pump was made this proposition was taken up by me with Mr. Witherup, Master Mechanic, who had some familiarity with the use of jets and after looking through some books and Hancock pamphlets with Mr. Witherup, I was convinced that he could build a pump that would do the work on this equipment and shortly thereafter he started building jets and testing them on the water hydrant at the machine shop. At different times when I was in the machine shop dis-

cussing the matter with Mr. Witherup I noticed that Mr. Liby, one of the machinists, was doing work on different parts of the jet, and I was present at the time the pump was tested. This jet was also tested before it was installed on the equipment and we found that it would pick up two or three feet on the suction side when charging oil through the jet with the Marsh pumps which were later used for charging the equipment. At that time I prepared some date on these tests but I have been unable to locate this at the present time.

After the original drawing was prepared by Smith a working drawing was made by a different draftsman in the Engineering Department, and I was rather disappointed that Smith had been taken off the job as he had become familiar with my work, I thought.

The apparatus, as actually built, differed in some respects from the working drawing. The furnace was not built in accordance with the blue-print but was built
4625 from knowlege obtained in certain tests made on the furnace of Experiment #6, in which the bottom part of the furnace was arranged so as to distribute the heat uniformly in the front, middle and rear of the furnace, and the furnace as built had horizontal instead of vertical baffles as shown in the working drawing.

The drum, which was built in the boiler shop under the supervision of Mr. Davis, was made with *(RIVETED) ~~welded~~ instead of *(WELDED) ~~riveted~~ joints, which construction was considered more safe by the Engineering Department at that time. I have identified the original tracing made by Smith of this apparatus, and subsequent work, as being the drawings which were made at the time, as referred to above.

An inverted U was placed in the vapor line so as to prevent the return of the backtrap to the still, which of course would cool the still. With this arrangement it was impossible for the backtrap to puke over and clog up the air condenser.

The apparatus above referred to was built in the spring of *(1917) ~~1916~~, and the following men worked on its construction:

Brick masons: B. J. Dempsey and Jack Gibbons;

Pipe Fitters: H. L. Wallace; J. H. Burlingham; G. V. Swearinger and W. J. Maguire.

* Matter in parentheses inserted.

The backtrap line was insulated, as well as the drum itself, but I do not recall who did this insulating work. The apparatus was built under a shed back of the laboratory and it was built under the supervision of Mr. J. H. Burlingham. After it was completed there were
4626 about seven runs made, the stock used being paraffin gas oil and kerosene distillate. The results of these runs showed that the drum would not stand sufficient pressure. When the pressure was brought up to about 200 pounds the manway head began to leak around the gasket on account of the bulging of the head and the flange on the manway which caused it to lift off the gasket. The flange and head were then reinforced but even then the equipment would stand only 300 pounds pressure. The coil caused a great deal of trouble on account of the expansion under heat which would cause the block headers to lift off of the gaskets. We found it almost impossible to prevent leakage around these headers. These block headers were taken from the old single coil apparatus and they were of poor design and had many mechanical defects.

During the runs on the coil and drum apparatus the backtrap was returned continuously to the *(HEATING COIL) preheater, with the charge, as was evidenced by the character of the distillate, the testing of the distillate, on some runs, and also in other runs by a comparative test of the distillate and backtrap. The operation was fairly smooth but it was evident that the equipment was not properly proportioned. The flow of charge and backtrap was too small in quantity for a three inch pipe and consequently the oil was retained in the coil for too long a period which gave more decomposition than was desired, thereby causing some carbonization of the coils. It was also evident that the velocity could be increased only by decreasing the size of the coil pipe and increasing the volume of the drum and the size of the air condenser, thereby increasing the quantity of charge as well as the backtrap returning to the coil.

4627 Notwithstanding the construction of the apparatus, however, the naptha distillate was of good color and good quality and of low heat reaction and the rate of yield was fairly satisfactory. The seven runs were made on this apparatus during May, June and July, 1917, the runs lasting from 20 to 85 hours *(EACH). In this small

equipment the radiation losses in the drum would, of course, be considerably greater than in a larger commercial sized equipment. The gasolene produced in this equipment was measured off in five gallon cans (TWO TANKS) and poured into steel drums. I believe that some of this gasolene was used by one of the stillmen, Mr. Pond, in his motorcycle.

The following men worked on this apparatus during the time it was in operation:

H. A. Pond
Paul F. Terrier
E. T. Earnest
R. L. Murray
M. Becker, and others.

It was evident, that on account of the improper proportion of this coil and drum apparatus it would be necessary to carry a high temperature in the coil in order to maintain the desired temperature in the drum. On kerosene stock we were unable to carry sufficient pressure to obtain desirable cracking temperatures in the coil or in the drum, consequently the cracking rate was very slow. However, in all the runs the backtrap was returned to the coil and cracking temperatures maintained in the coil and drum, and a satisfactory naphtha product obtained for fairly long periods of time. The tar was drawn off regularly so as to maintain a consfant oil level in the drum, which tar was discharged to a separate tank and never returned to the system.

4628

In all of these runs some cracking took place in the coil but the bulk of the cracking occurred in the drum. Although some carbon was found in the coils at the end of all of the runs, it was localized in the lower tubes, and in run #6 there was only a small amount of carbon. The cracking in the coil was due to the slow velocity of the oil through the coil, the comparative volume of the coil with respect to the drum and the radiation losses on the drum. Due to this small equipment it was necessary to carry a higher temperature in the coil in order to maintain the temperature in the drum and consequently some cracking took place in the coil, but the bulk of the cracking took place in the drum.

One of the points of particular interest at the time was the condition of the coil during the different runs, and in order to determine this condition the equipment was

shut down at times before it was necessary in order to examine the tubes and although there was a greater formation of carbon on the tubes than we desired, it was thought that this could be entirely eliminated by changes in the proportions of the equipment. In some of the runs where the coil temperatures were carried low there was very little carbon formation but in those runs where the temperature was purposely increased and an effort made to maintain this high temperature in the coil, there was considerable carbon formation. In most instances we found that the carbon was only in the lower row of tubes, and chiefly in the last tube of the lower row. We found
4629 that the carbon in the drum was more of a soft soot-like nature while the carbon in the coil was more of a scale on the bottom of the tubes. This carbon deposit on the bottom of the tubes was due probably to the stratification of the heavy residuum oil on the bottom of the tube and the vapors above, indicating that the velosity was not sufficient to thoroughly mix the oil and vapors.

The opefation of this coil and drum apparatus was discontinued, first, because of the difficulty encountered in overcoming leakage in the coil, second, because the drum would stand sufficient pressure and, third, because we had made sufficient runs on the apparatus to give us the idea of design of a semicommercial equipment so proportioned as to overcome the above difficulties.

As the result of this experiment a new design was worked up, which resulted in drawing No. Y2200 (*9/24/17*) and Y2282 (*12/5/17*). The purpose of this was to obtain a semicommercial still which would overcome the difficulties found in small coil and drum apparatus. The proposed equipment was changed in the following respects:

The coil was to be made smaller in cross-sectional area and longer in length so as to obtain a greater capacity and a higher velocity through the coil. The drum was to be made larger in order to obtain a greater oil volume and thus reduce the radiating surface. The air condenser was to be made larger so as to obtain more cooling and greater capacity, thereby increasing the flow of backtrap, and also insreasing the velocity of oil through the coil. This revised equipment had been talked over previously with Mr. Manley and Mr. Holmes and I was under the im-
4630 pression that it was to be taken up with the Engineering Department and constructed. I took the matter up with Mr. A. S. Bailey, who wanted the approval of

higher authorities before he proceeded to build the apparatus. Apparently he had obtained this authority because he took up with various manufacturers the question of materials for the equipment, but for some reason unknown to me this equipment was not built at that time.

While we were making the runs on the coil and drum apparatus Mr. W. T. Donaldson was going over the equipment with me in detail for the purpose of drawing up a patent application and I explained to him at that time the whole process and apparatus and some months later when Mr. Donaldson had finished a preliminary draft of the application it was gone over in detail by me. These conferences with Mr. Donaldson regarding the details of construction and operation covered a period of several weeks, as I now recall, and after these conferences with Mr. Donaldson it was several months before I finally executed the patent application. At the time I signed the patent application I wrote a letter to Dr. Mackenzie advising the inclusion of claims covering various combinations of stills and also furnaces for heating the stills.

About this time the coil of Experiment #8 was connected up to a series of six 12" pipe stills, which had previously been operated without any coil, and the backtrap on this apparatus was returned to the bottom of some of the stills. The charge was heated to approximately 4633 800° before introducing it into the bottom of the front still and by this means the furnace temperature was reduced about 250 to 300°. In these runs (*Oct. 24, 1918*) there was substantially no cracking in the coil because at the end of the run there was nothing but a soft soot-like coating of carbon in the tube. The cracking was confined practically entirely to the oil in the stills and all the stills were directly fired in order to maintain a definite cracking temperature. In all except the first few runs the stills were connected above the top brick work by an oil equalizing line below the oil level and a vapor equalizing line above the oil level. Tar was drawn regularly from still #6 and occasionally from the other stills so as to keep the lines clear. This tar was drawn off into a separate storage tank and was not returned to the system.

Several runs were made on this apparatus but it was finally discontinued on account of one of the stills bulging. In all of these runs substantially no decomposition took place in the coil the cracking being confined to the oil and the vapors in the stills. This experiment demon-

strated, also, that we could make a product of good quality and that we could run for a considerable length of time before carbonizing the stills and further that we could considerably reduce the heat on the stills. The heating of the oil to approximately the still temperature before introducing it into the still made the operation of the battery much smoother.

Previous to these experiments on 11-3 a new coil was designed. This matter was taken up with Mr. Hoffman of the Vilter Mfg. Company by Mr. Risden and myself. This coil was to be used on battery 3 of Experiment #18.
4634 Battery #3 of this experiment was equipped with one still. This resulted in the preheater shown on blue-print P-176 and as stated above it was installed on Battery #3, run 5.

In October, 1917, Mr. Burt Hull (*now at Houston*) and myself were called to New York for the purpose of consultation with Mr. R. C. Holmes regarding the installation of pressure stills. Somewhat previous to this time a drawing had been made up for a battery of five pressure stills but as a result of this conference it was decided to build three batteries of stills, two stills each in batteries 1 and 2 and one still in battery 3, the chief different between battery 1 and 2 being in the furnace design and the vapor and tar line connections. Battery 3 of one still was provided with a setting so that a second still could be put in similar to batteries 1 and 2. Due to my insistance it was decided at the New York conference to put just one still in battery 3 because I felt that it would be easier to operate it on account of oil levels and put in a preheater in the place provided for the second still. I believe that Mr. Manley was also present at some of these conferences. A design of this system was finally completed in detail and the three batteries were constructed under the supervision of Mr. F. B. Capen (*dead*) and they were all three put into operation at the same time (*Apr. 1918*). It was evident, however, from the start that it would require exceedingly high furnace temperatures to operate these batteries. They were operated under my direction and I found that it was too much of a task to operate the three batteries at the same time so later the furnaces of the batteries were al-
4635 tered and provided with flues so as to overcome the excessive heating of the front still but this was only a minor help.

As originally constructed the oil was preheated in an

economizer coil in the flue, but this only raised the temperature to about 200°. Later a gas burner was put in one end of the flue and the temperature was thus raised to 325°. This was about the time that Mr. Risden and myself had started to work on a design of preheater for battery 3, the purpose of which was to preheat the oil to still temperature, or slightly above still temperature.

When this preheater was finally completed and installed on Battery 3, run 5, we obtained a much smoother operation of the battery, and with very much lower furnace temperature, approximately 200° or 300°. There was no substantial cracking in the coil as evidences by the carbon formation, after the coil had been in use several months.

Four runs in all were made (runs 5, 6, 7, 8) with the preheater coil installed, and in which the backtrap was returned to the bottom of the still, with the exception of run 8, where a jet pump was tried out. The jet, however, had insufficient capacity for picking up all the backtrap and as a result part of the backtrap returned through the vapor line to the top of the still. The jet used on this apparatus was made by Mr. Fantz (*at St. Louis, not with Co.*—(illegible) *Run #8 2/25/19*) in the Machine Shop, and before it was installed it was tested under practical operating conditions at the batteries on cold oil.

On this apparatus the vapor line from the top of the still to the bottom drum of the heavy air condenser 4636 was so arranged that the backtrap could run back to the top of the still through the vapor line in case the jet did not pick up all the backtrap. It was originally constructed in this manner.

Previous to run 8 on this apparatus I made a trip to Boston for the purpose of investigating the Hancock Inspirator Company's jet pumps and after talking the matter over with their Mechanical Engineer and submitting data as to the pressure conditions of the battery, etc., it was his opinion that it would be impossible to pick up backtrap against a back-pressure of more than 25 or 30 pounds without using a higher charging pump pressure than was available on this apparatus. He suggested supplying their regular steam injector for experimental purposes, the tests on this device being reported back to them in order that they could work in conjunction with us in developing a satisfactory pump. At any rate further runs on battery 3 with a jet pump depended upon the development of a jet pump of greater capacity.

About the middle of July, 1918, soon after the operation of the auxiliary burners in the common flue to the batteries of Experiment #18, I suggested as a better scheme the installation of a separate coil for each battery in the flue and a separately fired (*heating coil*) preheater to heat the oil to 600° to 750°, before it entered the bottom of the still. The preheater coil was so successful on battery 3, run 5, that it was almost immediately thereafter connected
4637 to battery 2, which was provided with two stills. The coil proved to be just about the right capacity for two stills and the operation was, as in battery 3, much more uniform and it required much less intense furnace heat around the stills. There was no substantial decomposition in the coil as was evidenced by the inspections of the coil several months after. Backtrapping was to the bottom of the front still.

About this time, after a conference with Mr. Holmes and Mr. Manley, it was decided to connect up the battery of four stills. In this connection it was decided to take the best stills from the three batteries and combine them into one battery of four stills. These stills were connected over the top of the brick work of the furnace by an oil equalizing line below the oil level and by a vapor equalizing line above the oil level. Each vapor line from each side of the top of still 4, the rear still, was connected to a separate set of two air condensers and the backtrap was returned from the bottom of the heavy air condenser to a manifold which was connected at the bottom to each still so that the backtrap could be run to any one of the stills, or to all of the stills. The (*heating coil*) charging line was connected by a manifold at the bottom of the stills so that the oil could be charged to any one of the stills or to all of the stills. The furnace was constructed so that the stills could be end fired. The coil that had been used on battery 2 and 3 was to be used in conjunction with this battery of four stills. The battery was constructed in accordance
4638 with the above mentioned hook-up of connections, all of which were discussed at interviews at Houston between Mr. Holmes, Mr. Manley and myself.

The battery operated very smoothly only the preheater was too small for the battery of four stills and later another preheater of practically the same dimensions as the first was constructed and installed on top of the flue immediately back of the first preheater and with this arrangement the battery gave very satisfactory results and is

practically the same arrangement as was adopted in the first twenty-four commercial batteries of stills.

Twenty-nine runs were made on this battery and cracking in the coil was almost negligible because there was practically no carbon in the coil and it is my recollection that no tubes had been cleaned or taken out from the time the preheater coil was installed until the last run was made on the equipment. This experiment had demonstrated that with the preheater coil the furnace termperature could be materially reduced (from 200° to 300°) and a marked improvement in the operation of the battery was, consequently accomplished. It also demonstrated the extreme desirability of further reducing the furnace temperatures in the still and returning the backtrap through the preheater and heating it, together with the fresh charge to a temperature of approximately 800° before returning it to the still, instead of returning the backtrap directly to the stills as was done in #18.

4639 Experiment 11-B from 1918 and thereon had been operated as the forerunner of the operation of the commercial sized experiments #18. The coil had been installed and successfully operated in 1918 and had also been successfully operated on the commercial sized equipment of Experiment #18. Very soon after the completion of Experiment #18 in December 1919, extensive experimenting began on Experiment 11-B for the purpose of developing a means of introducing the backtrap through the preheater, together with the charge. The battery was provided with four 12″ pipe stills similar to Experiment #18. It was also provided with a preheater and an economizer and preheater connections so arranged that the still furnace gases entered the economizer section. It was equipped so that we could start a set of intensive experiments with different means for introducing the backtrap through the preheater section together with the charge.

Numerous devices were tried out for returning the backtrap to the coil. At first a jet pump similar to the one used on battery 3 of Experiment #18 was designed and built by F. C. Fantz, except that it was of smaller dimension; that is it was of a size suitable for this equipment. This jet pump was tried out on several runs and it operated fairly successful. The only trouble with this installation of jet pump was that the vapor connection from still #4 to the heavy air condenser was such that the backtrap

could be returned through the vapor line to the top of the still if the backtrap was not returned through the pre-
heater. This makes it difficult to prove that the jet
4640 pump was working. The vapor line return of back-
trap was purposely constructed so that if the means for forcing the backtrap through the coil did not work the battery operation could be continued so as to carry out the other experiments being tried on the battery, such as methods of charging, methods of drawing off the tar, float devices, etc.

The next scheme was the use of the distillate vapors and permanent gases from the light air condenser to operate the steam end of an ordinary pump for returning the back-trap to the preheater inlet as suggested by G. W. White (NOW AT PORT ARTHUR). This device was discontinued on account of the difficulty of keeping the packing tight and prevent (ING) corrosion of the valve mechanism.

The next device was one suggested by Mr. Candor (NOW N. Y. OFFICE) of the Export Department of the Texas Company. In this the fresh charge was introduced into the steam end of an ordin-pump for forcing the backtrap into the preheater inlet. The slide valve of the steam pump was not suitable for oil operation.

Then a small plunger type of pump was tried out.

Next a rotary pump designed by Mr. Parish (ON PAC. COAST NOT MITN CO.) was tried. This pump was unsatisfactory because of the expansion and sticking of the rotary parts.

We next tried a vertically mounted pump, hoping that the oil in the vertical column would keep cool and protect the packing. This was more satisfactory than the other devices but it was not perfected.

Subsequently different systems of check valves and ball
check valves were tried out and later, when we
4641 heard of the Thompson surge pump, our efforts were directed along that line as we decided that the most feasible plan for commercial operation would be the Thompson type of surge pump.

We then (*1919*) figured that the preheater and the device for handling the backtrap were perfected to such an extent that we were ready to put into commercial operation on a large size scale the process of Experiment #8 and for this purpose battery #14 was selected.

Battery #14 as originally constructed (*1920*) consisted of four stills mounted in a common furnace fired from

the end and provided with flues for carrying the high temperature gases back to the rear stills. It was provided with a preheater for heating the charge only and with air condensers and a backtrap from the heavy air condenser to any or all of the four stills. This arrangement was modified as follows (*1921*):

The combustion box at the front of the furnace was removed and the furnace remodeled and provided with pancake gas burners so as to obtain an even oven temperature. A surge pump was then installed and the backtrap line from the air condenser to the bottom of the stills was disconnected and connected to the surge pump so that the backtrap could be returned together with the charge through the preheater. The result of this change was that the furnace temperature was reduced from about
1800° F. to about 900 to 1100° F. which was caused
4642 by the return of the preheated backtrap to the preheater coil instead of directly to the stills.

The surge pump above referred to was a homemade device consisting of check valves, pipe fittings and surge lines leading to a steam operated surge block. This type of homemade surge pump was used until the present type of pump was adopted at a considerable later period (*1923?*), the present type being one built by the Worthington Pump Company.

The above outline of the experimental work conducted under my supervision is from my unrefreshed recollection and will be checked up and revised as found necessary after further consideration.

Experiment #9 (AUG. 30, 1916) was designed and constructed by others and I had nothing to do with it until the runs began. This experiment was started just before run #4 was completed on the single coil apparatus of Experiment #8. The apparatus consisted of six stills similar to the Wicks type of boiler. These stills were connected in series with oil overflow from the top of one still to the bottom of the succeeding still. The oil was charged into one end of the battery and drawn off at the opposite end through an oil level drum provided with a float indicator. The vapor line extended from the top of the still to an individual air condenser so that the backtrap could be
returned to the top of the still. Each still was in-
4643 dividually fired, the fire attacking the tubes only.

These stills were operated in series and in one or more units, but in all cases the stills would not stand the

pressure. Early in the operation one of the tubes of one of the stills blew out of the upper crown sheet when the still was under about 60 or 60 pounds pressure, causing an explosion, and several runs after this the equipment was abandoned. Some gasolene was made in this apparatus but on account of not being able to maintain pressure they were never brought up to operating conditions.

Finally the Wicks type of still was abandoned and the tubular part was replaced by a shell, which made a straight cylindrical still. These were mounted in the same position as the original Wicks type stills. This latter experiment was designated as Experiment #12 (*9/19/17*).

These stills were run as a battery of six and also as individual still for about a month but in all cases leakage was too great around the riveted joints before we could get up to working pressure. No satisfactory operation was ever made on this equipment. These stills also had back-trapping to the top of the stills as in the first installation. The backtrap was through a separate return line to the vapor space of the still. This battery of six stills was end fired instead of individually, the rear stills acting only as economizers.

About the time we finished with Experiment #9, Experiment 11A was started (*3/17/1917*) at the suggestion 4644 of Mr. Manley, his idea being to pump a light boiling oil through a high boiling oil, such as Electra bottoms. In this connection I suggested to Mr. Manley that his proposition was not feasible for the reason that the heavy residual oil would break down; that too much coke would form which would be destructive and that if the apparatus was run continuously the oil would be drawn out of the still. I wanted to connect the backtrap from the air condenser to the bottom of the still with the charge and suggested that gas oil or clean stock, suitable for the pressure obtainable in the still be used. This apparatus consisted of a 12″ vertical pipe still heated intermediate its ends and a air condenser at the top from which a return pipe lead to the bottom of the still. Several runs were made on this equipment in which Electra bottoms as stock was used and pumping gas oil into the bottom of the still. These runs showed that the Electra bottoms were soon broken down forming excessive carbon. After that gas oils of different boiling points were tried out to determine the range of cracking yields, etc., and we also made a series of experiments on different types of scrapers.

The first scraping device was of the steel brush type, the second type had spring arms attached to the scraper shaft, the third had rigid arms attached to the scraper shaft and the fourth was a flexible scraper, the adjustment of which was effectuated by means of a cable and weight.

On this apparatus I also provided a device for keeping the packing in the stuffing box around the scraper
4645 shaft cool, by welding a 3" vertical pipe, about 5 ft. long and providing the stuffing box with a shaft at the upper end of the pipe. This 3" vertical pipe was on the top head of the still and by this arrangement the packing could be maintained at very low temperature and there was no trouble in packing the shaft and prevent leakage.

Before we finished with Experiment 11-A we had obtained satisfactory operation for this type of still from the point of view of product and length of yield, and also had obtained satisfactory results with scrapers. In fact the flexible type of scraper is used on our present commercial type of still, the only difference being that on our present type we have an individual weight for each scraper instead of the cable arrangement. On this experiment it required a high temperature furnace in order to obtain satisfactory distillation rates and operation.

While operating Experiment 11A another Experiment, 11B was started (*8/29/17*). This apparatus consisted of six vertical 12" pipe stills similar to the still of Experiment 11A. The stills were mounted in one brick setting, the three front stills being directly fired and the three rear stills heated by the waste gases from the furnace of the front stills. This apparatus also required a high temperature furnace in order to obtain satisfactory distillation rates. The stills were first connected by combined oil and vapor equalizing line above the brick work of the furnace but this arrangement was not satisfactory and it was later
4646 changed by providing an oil equalizing line below the oil level and a vapor equalizing line above the oil level. Also the furnace was changed so that the three rear stills could be directly fired the same as the three front stills because the different oil temperatures in the stills caused considerable trouble in maintaining the oil level in the front and rear stills. The stills extended both below and above the furnace so that the middle portion only was fired. Without scrapers the carbon formation was very excessive along the sides of the stills but very satisfactory results were obtained with this battery of six stills as

they were finally arranged with the six stills directly fired and the oil and vapor equalizing line changes.

The next series of experiments on 11B was with the preheater of Experiment #8 for heating the charge to approximately distillate temperature before introducing it into the stills and also in trying out the type of scraper known as the Burlingham Type E. The rest of the experimental work on 11B has already been outlined. (THE ABOVE COVERS PERIOD FROM 1915 TO DATE OF FILING 11-21-18. FROM 11-21-18 TO ____ WHEN PROCESS WENT INTO COM. USE.)

2749

DX 746a

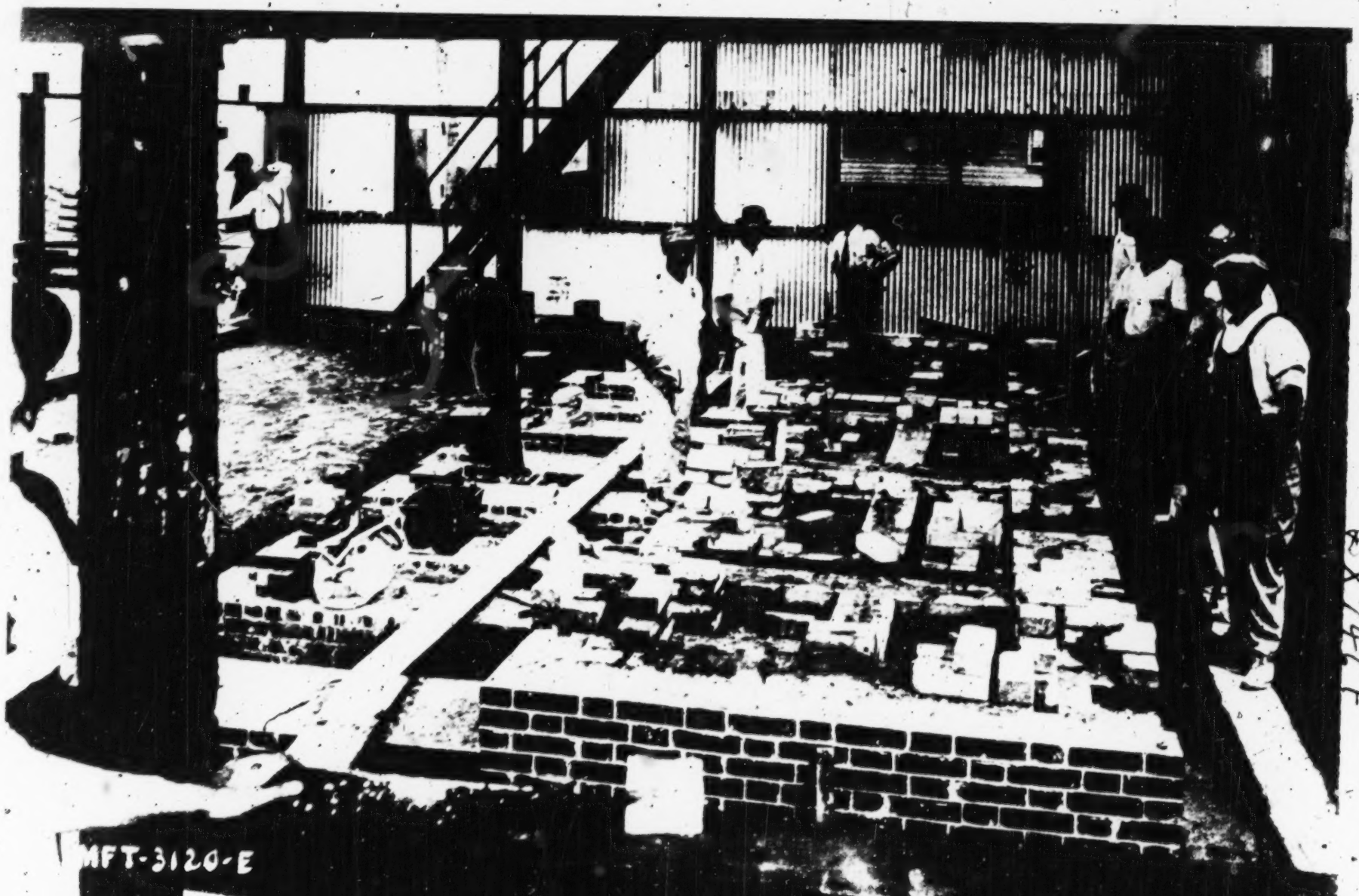
DX 746 B

9 DA246 6

DX 746

2757

~~VII~~ DX 746 E



MFT-3120-E

8X746

EX 746 H

DX 746 I

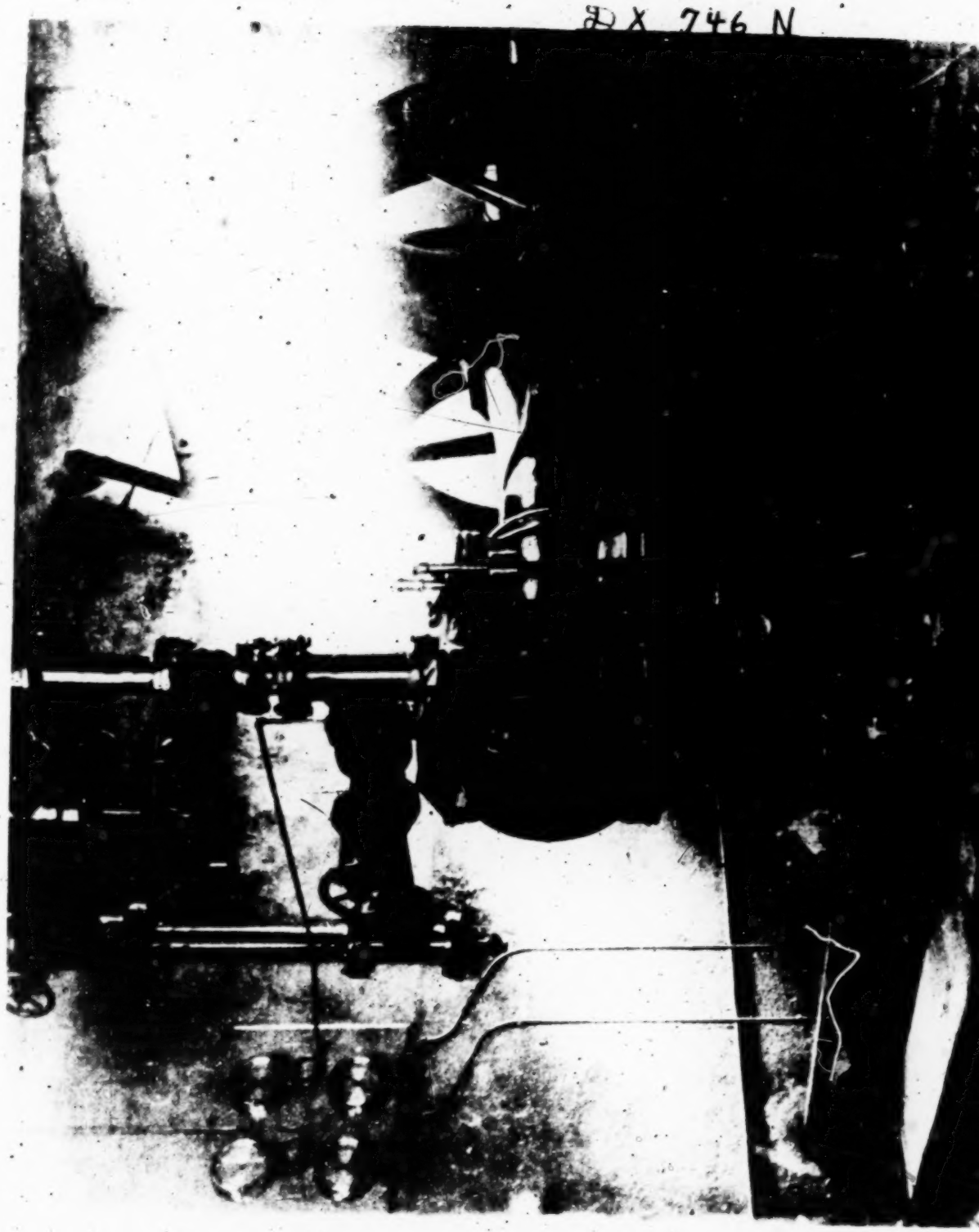
DX 246 J

DX 246 K

DX 746 L

DX 746 M

DX 746 N



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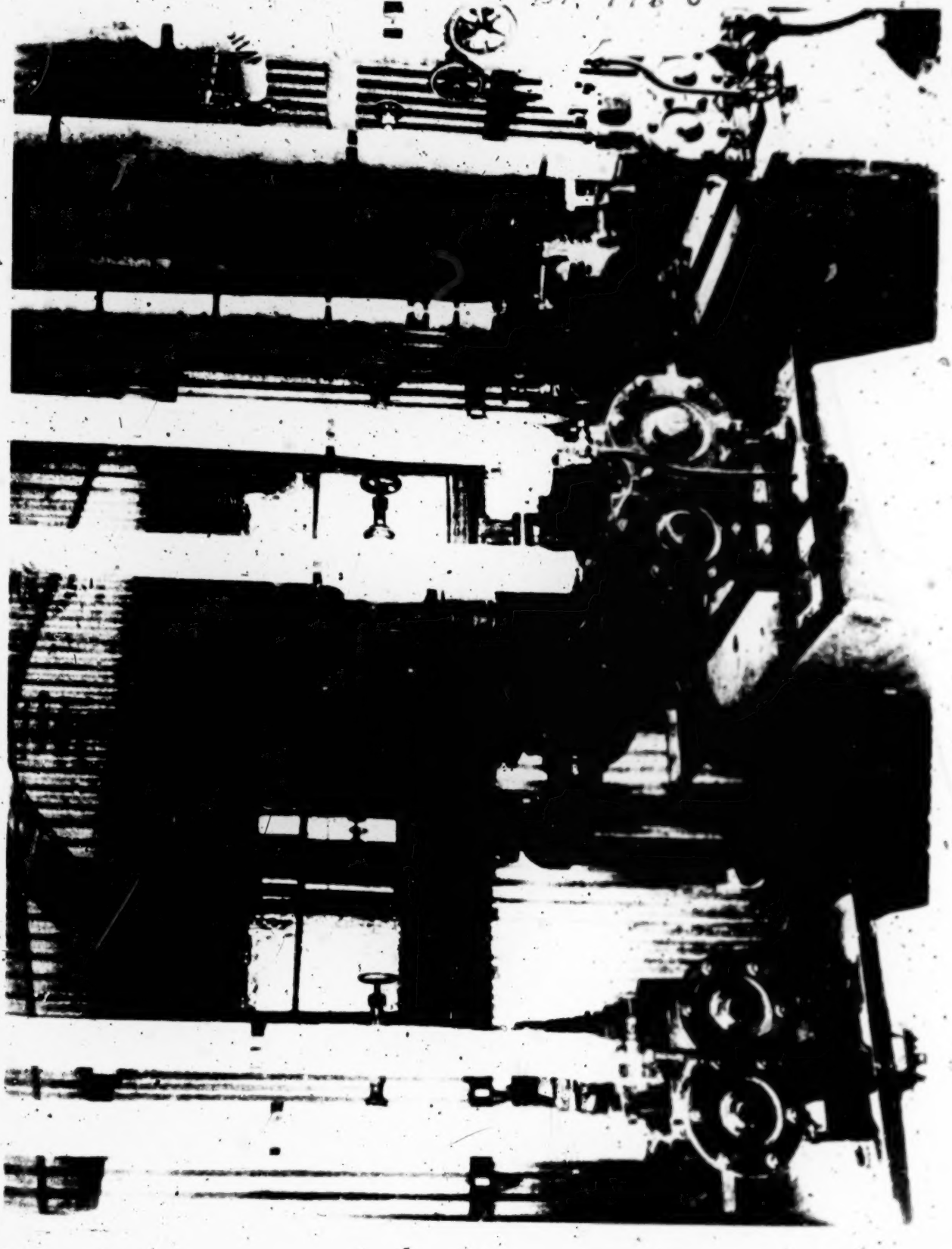


TRACING RECORD

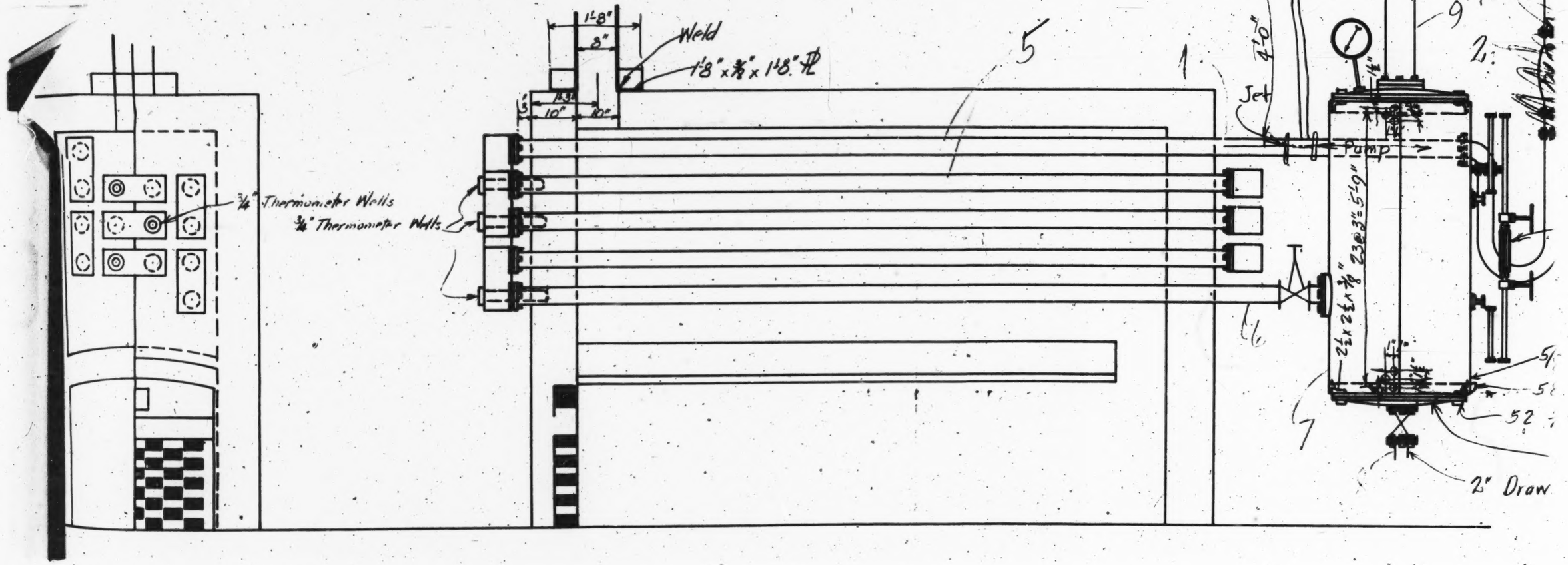
PORT ARTHUR WORKS

PAGE

NUMBER	DATE	TITLE	SCALE	SIZE	REVISED
[illegible]39	11/11/16	Alternations to Existing Coal Bldg. Sht. A-A"	1/4"=1'0"	22x14	
[illegible]	11/[illegible]/16	Door Frame for Fire Wall			
1611	✓	Boilers	1&2"=1'-0"	11x17	✓
		Supports for steam & Feed Water Lines. Ext. Boiler House #3. Est. #639	None	8½x11	✓ Void 11-17-16 ✓
[illegible]	11/2/16	Detail of Master Helper and Wire Traveler Bldg	1/2"=1'-0" 3"=1'-0"	22x34	
[illegible]		[illegible]			✓
[illegible]		[illegible]			✓
[illegible]		[illegible]			
[illegible]	11/4/16	Coal Pocket Tipple Bldg Scheme 1	1/4"=1'0"	22x34	✓
1637	11/4/16	" " " " " 2.	✓	✓	✓
	11-4-16	-Revised, Standard Stenciling & Safety Appliances for T.I.Co. -Ink-Cars-	1½"=1'-0"	2'-6"x5'-10"	
[illegible]		Burton Stills Layout	½"=1'-0"	22x34	✓
1649		Supports for Clay Line to Burning Oil Agitators Est. 1802	None		
[illegible]		Feed Water Lines. Ext. Boiler House #3 Est. 1639	1"=1'-0"	17x22	✓
[illegible]	[illegible]/16	Shaft for Driving Pulley on Rear Pumping Plant	3'-0"=1"	22x51	✓
				16x11	

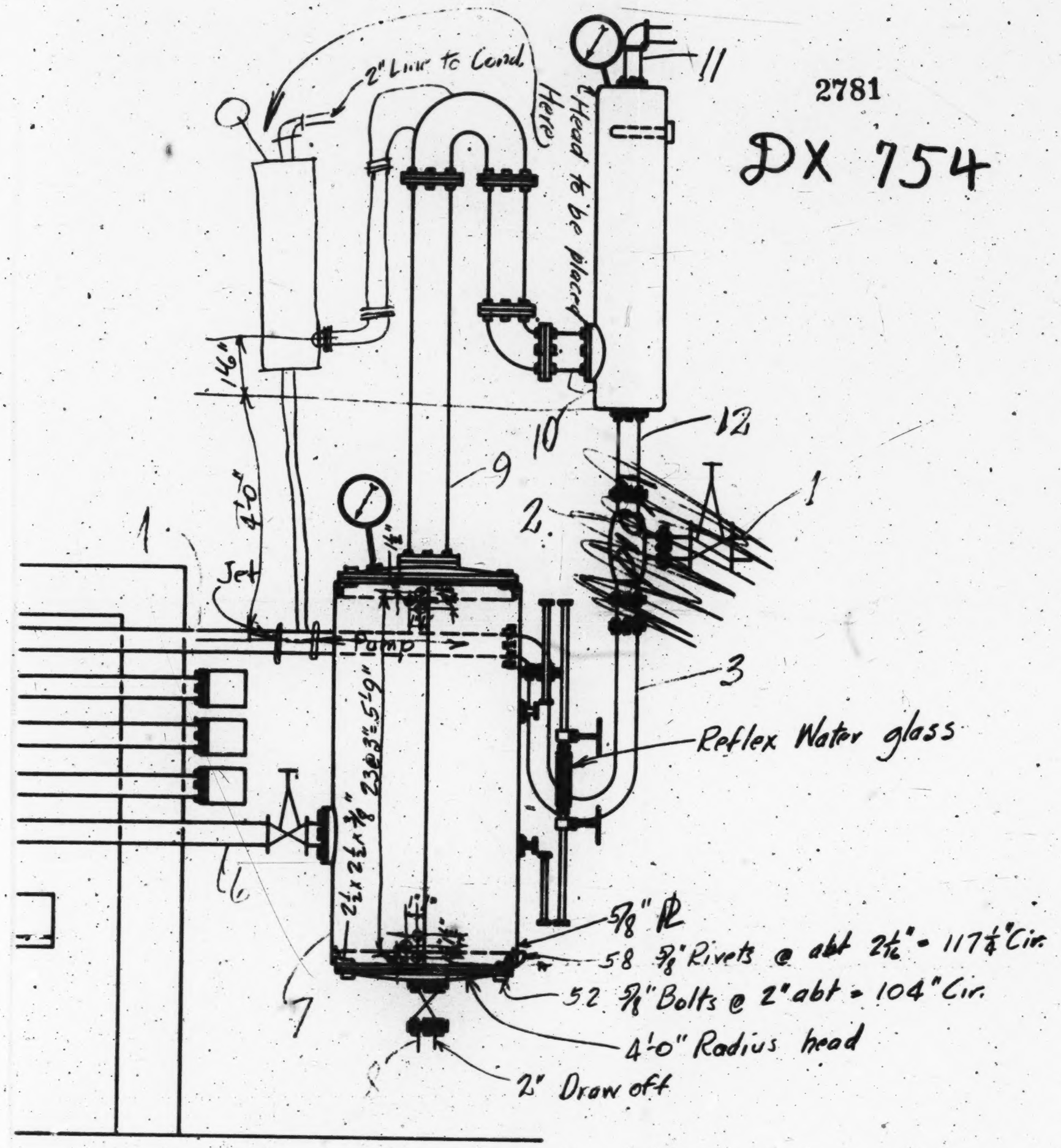
DX 752

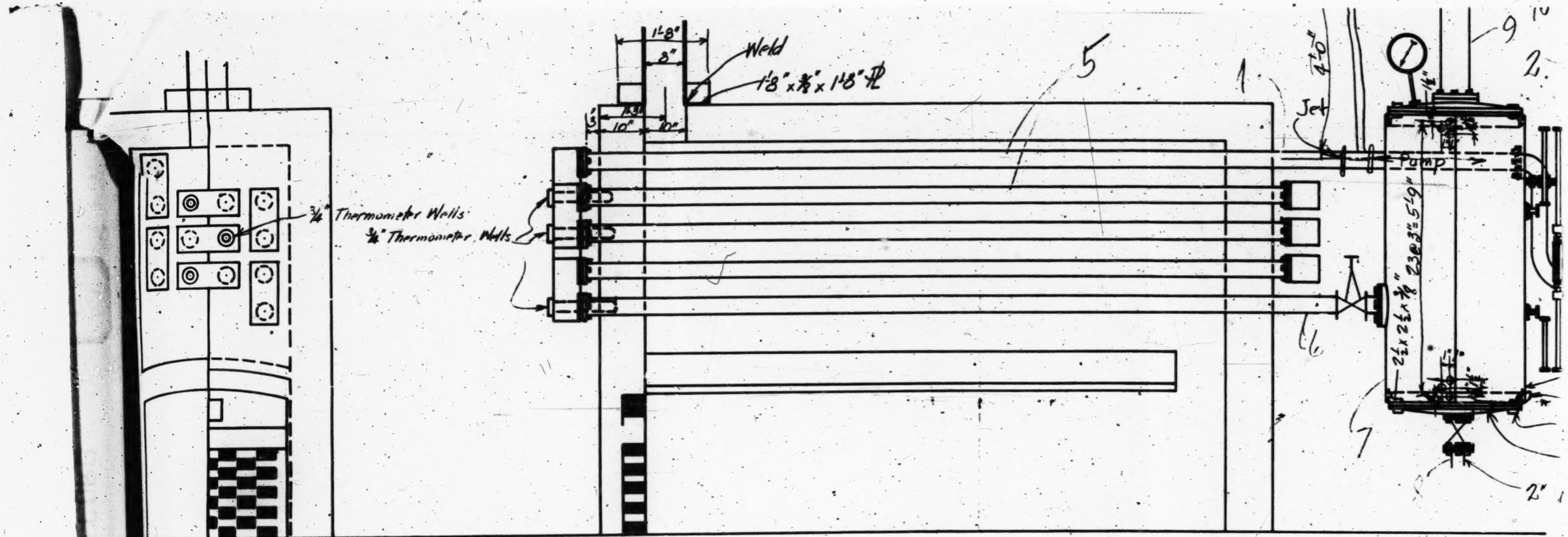
2778


1'-8"
8"
Weld
1'8" x ⅜" x 1'8" ℄
10"
10"
¾" Thermometer Wells
¾" Thermometer Wells
2" Line to Cond.
Head to be placed Here
1'-6"
Jet
2" Draw

2781

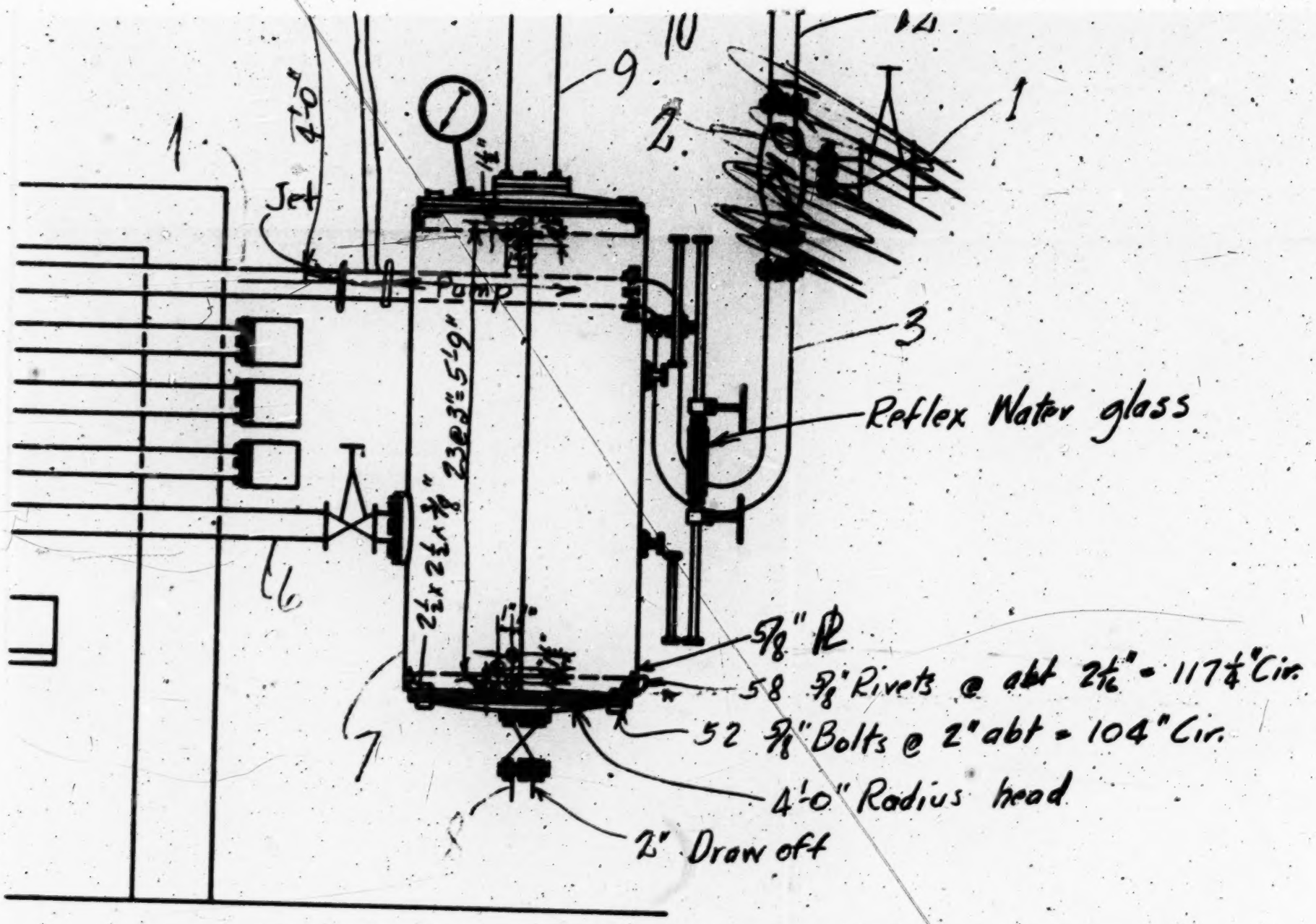
DX 754


2" Line to Cond.
Here
2" Head to be placed
11
12
10
9
1
2
3
14"
Jet
Pump
1
4'-0"
2½ x 2½ x ⅜ 23 @ 3" = 5'-9"
Reflex Water glass
⅝" Pl
58 ⅝" Rivets @ abt 2⅛" = 117¼" Cir.
52 ⅝" Bolts @ 2" abt = 104" Cir.
4'-0" Radius head
2" Draw off



Note: This tracing (i.e. the inked portion) was traced from a pencil drawing made on manilla paper Apr. 22, 1936, which was made by measuring and scaling an old blueprint under glass printed from Port Arthur Works Drawing numbered 1848 and dated 11-6-'18. The pencilled notations hereon were copied freehand from the old blueprint mentioned above.

By H.A.Smith.

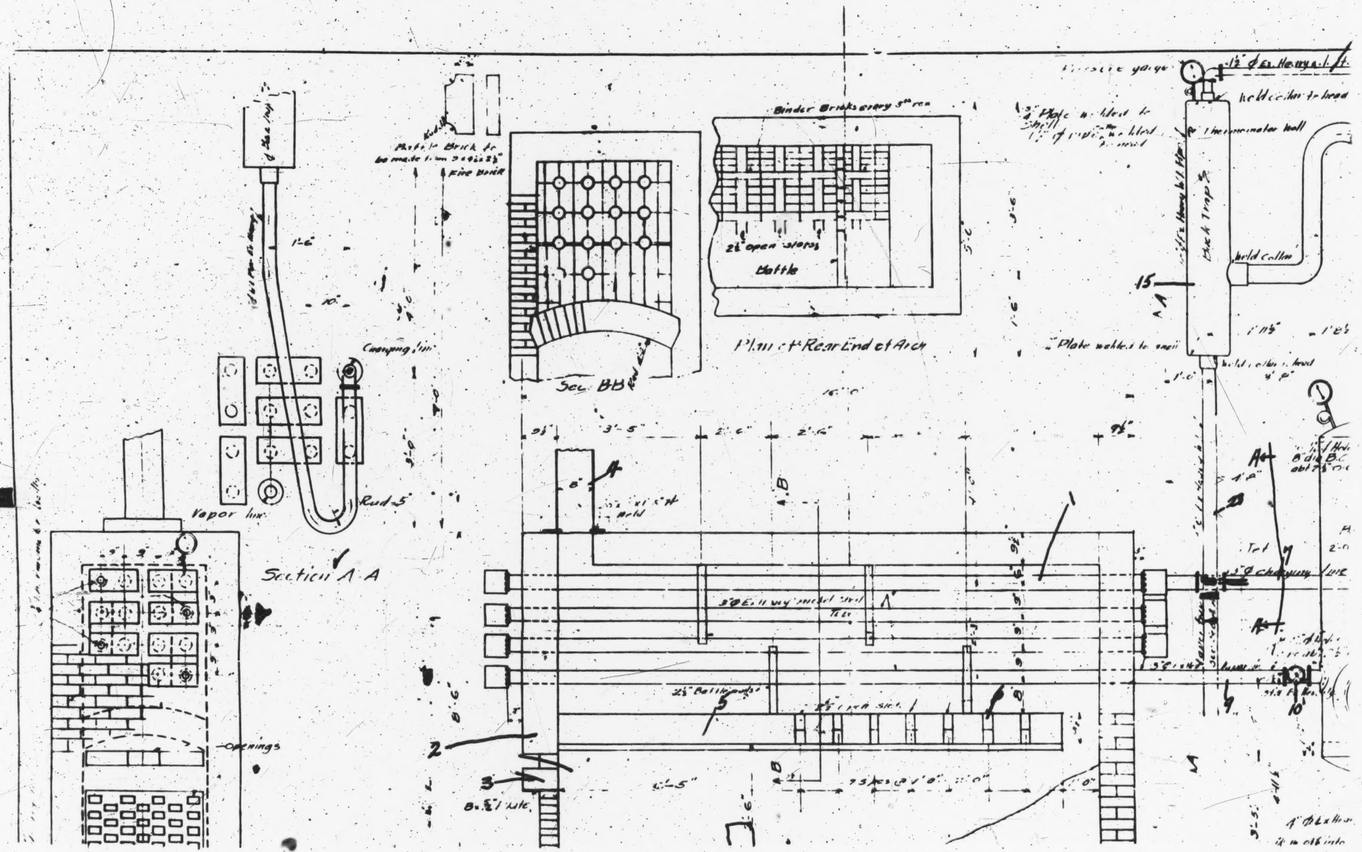


Exp. 8

1 manilla print under 1 11-6-16. print

4.

THE TEXAS COMPANY		
★	REFINING DEPARTMENT PORT ARTHUR WORKS	★
Coil Still (To be traced over.)		
SCALE: 1" = 1'-0"	DATE: 11-6-16	REVISED:
DRAWN BY	SUPPLEMENTAL NO.	PRINT NO. 1643
CHECKED BY		


Section A-A
Sec. BB
Vapor line
Casing line
Rod-5
Openings
Plan at Rear End of Arch
Binder Brick every 5th row
28" open joints
Bottle
Hold collar to head
Thermometer ball
Back Traps
Plate welded to shell
Hold collar to head
Tel
Chimney
Hold collar
Hold collar to head
Plate welded to shell
Hold collar to head
Hold collar
Back Traps
Thermometer ball

Vapor line

Rod-5

Section A-A

openings

4'-10"

Front Elevation

Section thro' A of Still

Specifications for 2'-0" Use Drum

Inside diameter = 2'-0"

Shell to be ¼" Steel plate

Heads to be ¼" thick to 2'-0" Radius and riveted to shell (as below)

Longitudinal joint to be double riveted in 2 rows of holes ⅝" Ø rivets; Space at 2¼" c.c. for all holes

Manholes and lugs as detailed above

Min. thickness of Metal in lugs to be ½"

Manhole casing to be ¼" thick

" Cover to be ¼" steel plate reinforced as shown above

In dished head of drum use 3 rows of ⅝" Holes 2¼" c.c. for all Holes, 2" between rows.

Longitudinal joint for 2'-0" Drum

Section thro' A of Still

4665 DX 756.

The Texas Company

Port Arthur, Texas, February 2, 1918.
Holmes Gasoline Process
Coil & Drum.

Personal
Mr. R. C. Holmes,
New York, N. Y.

Dear Sir:

I inclose copy of the specifications which I have prepared on the coil and drum arrangement, and would be glad to receive any criticisms or suggestions that you wish to make in regard to same.

As I had anticipated, Mr. Behimer was plainly disappointed in not having his name connected with this application. He claims that the use of the drum in connection with the coil was suggested, as well as developed by himself, and that it is this feature which makes the system a patentable one.

I take it that our object is to secure a patent for The Texas Company and not for any particular individual, and, of course, whoever may be the patentees, The Texas Company would have the beneficial use of the patent; but, of course, a patent to have any validity must be taken out in the name of the actual inventors, hence it is my suggestion that before the application is filed, great care be taken to see that it is taken out in the proper names.

Of course, I know nothing of the genesis of this 4666 system except what Mr. Behimer has told me. If I were in possession of all the facts of the case, I would be in a better position to advise as to the proper parties in whose names the application should be filed.

Yours truly,

Wm. T. Donaldson.

WTD-MO'N
FTM

4667 To All Whom It May Concern:—

Be it known that I, Ralph C. Holmes, a citizen of the United States, residing at New York, in the county of ....., and state of New York, have invented certain new and useful improvements in Processes and Apparatus for Making Gasoline.

This invention relates to a method and apparatus for making condensable light oils, such as gasoline. More particularly it relates to certain novel improvements in the cracking of hydrocarbons whereby higher boiling hydrocarbons are decomposed into those of lower boiling point.

In prior methods of cracking hydrocarbon oils, considerable difficulty has been experienced on account of carbon formations, which occur on the sides of tubes and stills exposed to the heat required to carry on the cracking operation. It is a novel feature of the herein disclosed process, that the cracking operation occurs in a vessel to which no external heat is applied, except at times that necessary to overcome heat radiation, the oil prior to its introduction to such vessel having been subjected to a high degree of heat and the excess heat of the oil itself being used to effect its own decomposition. As a consequence the carbon formations which have constituted such an impediment to prior methods, do not occur in our system. The removal of the cracking operation from the heating zone also reduces the danger from fires such as frequently occur where cracking is carried on in highly heated stills and oils exposed to direct heat.

Our process embodies a novel circulatory system 4668 in which a ring of oil is constantly maintained under varying liquid and vapor phases. The oil to be treated on entering this ring is subjected to a high degree of heat, but the time element is so controlled that there is comparatively little decoinposition while it is exposed to this external heat, the oil being rapidly removed from the heating zone and conducted to the cracking zone, where without being subjected to any additional heat, it undergoes a molecular decomposition whereby light products are formed. The residual oil containing carbon and asphaltic bodies produced by the cracking operation is withdrawn from the ring. The light products continue the cycle, leaving the cracking zone in the form of vapor and gas. These vapors and gases are then subject-

ed to a reduction in temperature, whereby the heavier constitutents such as kerosene, are condensed. This condensate is combined with the charge of oil entering the heating zone thus completing the cycle. The constituents of the desired volatility are removed from the ring and condensed. The outlets from the ring are so controlled that the entire system is maintained under a pressure sufficient to insure the desired molecular transformation.

Our process is to be distinguished from those of the prior art, in which a ring of liquid residuum is kept in circulation. When such oil is kept in circulation, considerable quantities of carbon are formed, owing to the readiness with which this type of oil carbonizes when exposed to high temperatures, the carbon forming in fine particles in the oil, and where-ever it comes in contact with heated metal surfaces, it attaches itself thereto and builds up deposits, causing bulging and breaking of such surfaces, and also causing the choking of tubes and coils. In our system, we do not circulate a residuum, but instead, remove the residuum, containing the carbon and asphaltic bodies, from the cycle at the Cracking zone, and continue the cycle by means of the vapor generated, which contains the condensable product desired and also certain heavier constituents which are used to complete the cycle. By removing the residuum from the cycle as it is formed, we keep the ring free from this source of carbon formation, and since we conduct the actual cracking in a vessel unexposed to external heat, we are thus able to effectively remove the carbon formed.

4669

In cracking oil for gasoline, there is generally formed a considerable quantity of vapors heavier than gasoline, which may be generally designated by the term, kerosene. We employ these heavier vapors as a solvent for the lighter vapors; they assist in maintaining a current of vapor by which the gasoline is removed from the cracking zone to a separator where the kerosene vapors are reduced in temperature sufficiently to separate them from the vapors of the volatility desired for gasoline. The kerosene condensate preferably at a temperature not materially below its boiling point, is inject-

ed into the oil charge entering the heating tubes, whereby a foamy mixture is produced, which accelerates the circulation in the heating tubes thereby preventing the oil from being over heated, and also keeping the tubes swept free from any carbon formations. These kerosene constituents are an excellent mechanical conductor of heat, and there is thus produced a heat cycle which maintains the proper temperature in the cracking zone. By maintaining these bodies in constant circulation, the kerosene constituents, which under existing methods have been found so difficult to decompose into lighter products, are, in our system, ultimately reduced to gasoline.

I have devised certain novel apparatus for carrying out my process, and illustrate the preferred form thereof in the drawing which represents a diagrammatic, 4670 verticle plan view of said apparatus.

The coil 1 is located in the furnace 2, having the burner 3 and the stack 4. A checkered brick baffle 5 having the openings 6 may serve to distribute the heat evenly over the coil. The charging line 7, having the jet 7a, extends to the pump 8, which is connected to a suitable source of oil supply not shown. The pipe 9, having the valve 10, extends from the heating coil 1 to the cracking drum 11, within which it terminates in the distributor 9a. The cracking drum is preferably heavily insulated against heat radiation and is equipped with the valved draw-off 12, and the vapor outlet 13. It may also have an oil guage 14. The vapor outlet 13 extends to the separator 15, having the vapor outlet 16, and the condensate outlet 17. The vapor line 16 terminates in the water-cooled condenser coil 18, having the outlet 19 equipped with the valve 20. If desired the valve 20 may be placed in the vapor line 16. The outlet 19 terminates in the collecting drum 21, having the valved gas outlet 22 and the valved condensate outlet 22. The consensate line 17, which is preferably insulated, is connected to the charging-line 7 at the jet 7a.

In conducting the process with the apparatus illustrated, the oil to be treated is forced through the charging line 7 under considerable pressure, ordinarily from 50 to 100 pounds higher than the pressure desired for cracking. The oil is forcibly and rapidly circulated through the heating coil 1, where it is heated to the desired temperature. This temperature is generally from

50 to 100 degrees higher than the temperatures at which it is desired to conduct the cracking operation, and ordinarily varies from 800 to 900° F. The oil on being circulated through the coil acquires considerable heat,
4671 but on account of the rapidity of it flow decomposition is only in the insipient stages, the oil being withdrawn into the outlet 9 as cracking develops and is passed into the cracking drum 11 where a constant body of oil is maintained at a cracking temperature. The distributor 9a serves to discharge the oil into the cracking drum in a wide stream, thus spreading out the vapors and gases in the stream whereby their heat is diffused throughout the body of oil in the drum. This heat diffusion is materially aided by using a distributor with serrated edges.

The rapid circulation of the oil having been suddenly suspended, and the oil having entered a chamber of ample volume, the excess heat of the oil operates to maintain the body of oil at the desired cracking temperature and molecular decomposition is carried on vigorously, the higher boiling hydrocarbons continually breaking up into hydrocarbons of lower boiling point. The vapors and gases generated gather in the upper part of the cracking drum and pass out through the vapor outlet 13 to the separator 15, where there is effected a separation of hydrocarbons of desired volatility from those of less volatility than desired. The hydrocarbons of the desired volatility pass out through the vapor line 16, by which they are conducted to the condenser 18, where they are condensed and the condensate is from time to time allowed to run into the collecting drum 21.

The temperature in the air condenser 15 is such that the less volatile hydrocarbons are condensed and dropped into the conduit 17, by which they are conducted to the jet in the charging line. The separator is preferably somewhat elevated so as to give a considerable head of liquid in the pipe 17, which preferably contains a U bend as illustrated in order to form a liquid seal therein. This head of liquid, together with the high pressure
4672 at which the oil in the charging line passes the jet insures that the condensate shall be constantly drawn into the charging line and forced into the coil 1. The introduction of this condensate into the charging line brings into the oil charge an oil of comparatively low

viscosity so that the flow of oil in the heating coil is promoted and the coil is swept free from any carbon formations. This condensate consists in a type of hydrocarbons which when decomposed does not yield any great amount of carbon so that the oil charge is constantly being diluted with oil capable of being decomposed into lighter products without the production of large amounts of carbon. This condensate reaches the jet in a heated condition, preferably at a temperature not materially below its boiling point, so as to heat the charge of oil entering the heating coil. The heat cycle formed by the kerosene constituents enables the maintenance of the proper cracking temperature in the cracking drum.

By means of the valve 20 a considerable pressure is maintained throughout the system. The pressure used varies with the character of the oil operated on and on the character of the product desired. Ordinarily the decomposition in the cracking drum is carried on under a pressure of from 100 to 400 pounds.

The oil to be decomposed is constantly forced into the heating coil thereby causing a steady stream of heated oil to enter the cracking chamber. The vapors and gases are removed from the cracking chamber, and the residuum containing carbon and asphaltic bodies is from time to time withdrawn through the outlet 12. There is thus maintained a constant body of oil undergoing decomposition.

It is desirable to have a valve 10 in the conduit 9 so that in case there is a break in the heating coil the effect of any fire resulting may be localized 4673 by closing said valve whereby the bulk of oil in the system will be retained in the cracking drum 11.

It is sometimes necessary to apply an auxiliary heat to the cracking drum. A convenient method of providing this auxiliary heat is to insulate only the upper part of the drum and encloses the lower portion in a furnace. In the early stages of a run since there is no danger of overheating a carbon-free surface, the drum may be heated freely until the necessary heat cycle has been generated and decomposition has begun. But when decomposition begins, with a consequent deposition of carbon, the fire must be reduced as otherwise the carbon would accumulate on the hot surfaces and build up tenacious formations thereon, thus preventing the effectual

removal of the carbon and ahphaltic bodies. As the run continues only a moderate heat is applied, sufficient only to offset the loss of heat due to radiation. If desired the drum may be heated by means of waste heat.

The product obtained by the herein disclosed process is, for a cracked product, a remarkably sweet, saturated one. Judging by all the usual tests it appears to contain ordinarily not over 10% of unsaturated bodies, I attribute this low percentage of unsaturated compounds to the fact that the bulk of the decomposition of the vapors is carried on while they are in solution and unexposed to heated metal surfaces exposed to direct heat.

It is understood that I use the term "gasoline" and "kerosene" in this application in a somewhat broader sense than they are ordinarily used in the art. By the term "gasoline", as used herein, I mean the volatile product desired which under the temperatures and pressures used is a vapor in the separator 15 and is condensable in the cooling coil 18. I designate by the term "kerosene" those constituents which under the temperatures and pressures used enter the vapor line 13 in the form of vapor 4674 and are condensable in the separator 15. It is to be noted that the character of the constituents which I have found convenient herein to refer to as kerosene may sometimes comprise such products as are commonly known in the art as spirits or turpentine substitute.

Having thus described the invention what is claimed as new and desired to be secured by Letters Patent is:—

1. The process of converting a higher-boiling hydrocarbon oil into lower-boiling hydrocarbons which consists in rapidly forcing said higher boiling oil through a heated area of limited extent whereby the oil absorbs considerable heat and then passing the heated oil into a chamber under pressure and allowing the heat in the oil to effect its decomposition.

2. The process of converting hydrocarbon oil by continuously injecting same into a hydrocarbon ring, maintained under pressure, in which the oil is circulated through a heated coil whereby it acquires considerable

heat but is removed therefrom before any material decomposition sets in, passing said oil into a body of oil maintained at a cracking temperature by the continual entrance therein of the stream of oil from the heated coil, removing from the cracking zone the residuum and vapors formed, separating the less volatile constituents of the latter and intermingling them with the stream of oil entering the heated coil, withdrawing from the ring and condensing the gasoline formed.

3. In the cracking of hydrocarbon oil, the step of removing the oil from the heating zone and allowing the heat contained in the oil to effect its decomposition.

4. In a system of converting hydrocarbons in which a body of oil is maintained under a pressure and temperature sufficient for cracking, the method of main-
4675 taining a kerosene heat cycle which consists in removing
from said body of oil the generated vapors, separating the kerosene therefrom, mingling said kerosene with a stream of oil passing through a heated area and discharging the heated mixture into the body of decomposing oil whereby said body of oil is maintained at a cracking temperature.

5. The method of cracking hydrocarbons in which a body of oil is constantly maintained under pressure and at a cracking temperature, the necessary heat for decomposition being supplied thereto by a stream of heated oil entering said body of oil.

6. The continuous method of converting hydrocarbons which consists in forcing hydrocarbon oil under pressure into a heated coil and regulating the flow therein so that it absorbs considerable heat, removing said oil from the coil before any material decomposition sets in and conducting it to a vessel maintained under pressure and unsubjected to external heat where cracking is carried on by means of the heat contained in the oil, removing from the cracking zone the residuum and vapors formed, separating the less volatile constituents of the latter and injecting them into the oil entering the heating coil.

7. The process of converting hydrocarbon oil which consists in continuously forcing said oil through a coil at a rate of flow sufficient to prevent deposition of any material amount of carbon and heating it to a

temperature varying from 700° to 900°F., continuously removing said oil from the coil before extensive cracking takes place and introducing it into a body of oil whereby said body of oil is maintained at a temperature sufficient for decomposition without the application of external heat thereto, removing the residuum and vapors formed, separating the heavier of the vapors and continuously
4676 injecting them into the heating coil, while maintaining
a pressure of upward of 100 pounds throughout the system.

8. In the cracking of hydrocarbon oils, the step of removing carbon and asphaltic bodies, which comprises carrying on the cracking operation in a vessel unsubjected to external heat (the necessary heat for decomposition being supplied thereto by means of a stream of heated oil entering therein), whereby the carbon and asphaltic bodies accumulate in the bottom of the vessel from where they are withdrawn.

9. The process of converting hydrocarbon oil which comprises circulating said oil through a heated coil until the oil acquires a temperature varying from 700° to 900°F, continuously removing said oil from the coil and introducing it into a body of oil whereby said body of oil is maintained at a temperature not substantially more than 50 to 100 degrees lower than the temperature of the stream in the coil thereby subjecting said body of oil to decomposition, removing from the cracking zone the residual bodies and vapors formed, separating out the heavier of said vapors and continuously injecting them into the heating coil, while maintaining a pressure of upwards of 100 pounds throughout the system.

10. The process of converting hydrocarbon oil which consists in forcing said oil through a coil and drum while applying heat to said coil and drum and allowing the vapors generated to develop pressure until decomposition of the hydrocarbons begins, then reducing the heat applied to the drum while securing it against substantial loss of heat through radiation and supplying the necessary heat for decomposition by means of the stream of oil entering from the coil, the stream entering from the coil being continuously commingled with a hot condensate separated out from the generated vapors.

4677 11. In apparatus for converting hydrocarbons, a charging line, a heating coil connected to a cracking

drum, vapor and residuum outlets therefrom, a separator at the termination of the vapor line, a condensate pipe leading from the separator to the charging line.

12. In an apparatus for converting hydrocarbons, a heating coil, means for admitting oil thereto, an outlet from the heating coil terminating in a distributor located within a cracking drum, vapor and residuum outlets from said cracking drum, a separator connected to the vapor outlet, and a vapor outlet terminating in a condenser.

13. In apparatus for cracking hydrocarbon oils, a drum substantially secured against heat radiation and heated by means of a conductor in communication with a heated coil and adapted to eject heated oil into the drum, means for removing the vapors from the drum and means whereby the heavier thereof are condensed and injected in a heated state into the coil.

14. In apparatus for cracking hydrocarbon oils, a heating coil connected to a cracking drum by means of a valved conduit, vapor and residuum outlets from the drum, a separator connected to the vapor outlet, means whereby condensate from the separator is injected into the heating coil, and means whereby vapors from the separator are
removed therefrom and condensed.

15. In apparatus for cracking hydrocarbons, a coil subjected to furnace heat and communicating with a cracking drum, auxiliary means for heating the drum, means
for securing the drum against loss of heat from radiation, vapor and residuum outlets from the drum, a separator connected to the vapor outlet and having a condensate conduit connected to the coil, means for withdrawing vapors from the separator and condensing same, means for regulating pressure in the apparatus.

4678 16. In apparatus for cracking hydrocarbons, a heating coil communicating with a cracking drum, means
for withdrawing carbon and asphaltic bodies from the drum, a vapor line connecting the drum with a separator having vapor and condensate outlets, means in connection with the condensate outlet for injecting condensate into the heating coil, means for removing vapors from the separator and condensing them and collecting the condensate, means for regulating pressure in the apparatus.

17. In the cracking of hydrocarbon oil, the step of removing the oil from the heating zone and allowing the heat contained in the oil to effect its decomposition in a chamber unsubjected to external heat except such as may be necessary to prevent undue heat radiation.

4680 DX 758.

The Texas Company

New York May 17th, 1916

Personal

Mr. F. T. Manley,
Port Arthur, Texas.

Dear Sir:—

I wish as soon as you have the experimental plant at Port Arthur connected up in the way I have outlined, in the event that I have not by that time arrived in Houston, that you would wire me.

In the meantime I will ask that you and Dr. Gray and others at the plant who know in a general way what we are doing refrain from discussing the matter in any detail with anyone.

Yours very truly,

RCH-HD R. C. Holmes
GWG

4681 **DX 759.**

Port Arthur Works, June 20th, 1917.

Continuous Tube Process.

Personal.
Mr. F. T. Manley,
Houston, Texas.

Dear Sir:—

These runs were made on the new coil, this coil being a modification of the old one. The tubes are all the same length in this installation and they consist of a 3″ diameter, extra heavy nickel steel tubes, 16′-10″ in length, the total length of the coil being 236 feet.

The other improvements on this coil are the carbon catchers and the new form of dephlegmator. The disposition of the different parts can be seen in the attached blue print.

The oil was pumped through at the rate of 30 gallons per hour, but this speed was at times increased to as high as 45 gallons per hour. The gas pressure was regulated by means of a needle valve in the gas line from the distillate drum. A constant level of oil was maintained in the large drum at the back, and the speed of the pump is regulated according as the oil rises or falls in the gauge.

The stock used in these runs tested as follows:—

Data on Run.

	Run No. 6	Run No. 7	Run No. 8
Gravity	37.5	37.5	37.5
Flash, Cleve.	190	180	165
Fire	230	220	220
Viscosity	34/100	36/100	38/100
Pour	0	0	0
Distillation	200 cc	200 cc	200 cc
Start	391	390	330
10%	463 — 42.7	462 — 42.7	462 — 43.0
20%	484 — 40.5	485 — 40.8	486 — 40.3
30%	496 — 39.8	500 — 39.6	500 — 39.4
40%	510 — 39.0	512 — 39.2	512 — 38.8
50%	524 — 38.4	524 — 38.6	524 — 38.1
60%	538 — 37.7	534 — 37.8	538 — 37.4
70%	554 — 37.2	554 — 37.0	554 — 36.8
80%	573 — 36.5	578 — 36.3	580 — 36.1
90%	604 — 35.1	608 — 35.1	614 — 34.8
95%	664	642	640
E.P.	.....	663	678 — 31.5
% Rec.	.....	98.0	98.0

4682

Data on Run.

	Run No. 6	Run No. 7	Run No. 8
Time of run	50.5 hours	19.75 hours	29.5 hours
Charge	1258.99 gals.	581.46 gals. (?)	1007.7 gals.
Distillate	363.72 gals. 28.88%	484.68 gals.	483.0 gals. 47.94%
Residue	846.68 gals. 67.26%	164.64 gals.	456.75 gals. 45.34%
Gas	1683.49 cu. ft. 2.0%	1487.9 cu. ft. 3.8%	2558.2 cu. ft. 3.8%
Carbon	Not determined	Not determined	Not determined
Average Pressure, coil	200 lbs.	200 — 260 lbs.	275 — 290 lbs.
Average pressure, Rec. drum	50 lbs.	50 lbs.	50 lbs.
Average temperature furnace	1200 — 1650	1200 — 1700	1200 — 1700
Average temperature coil	550 — 830	550 — 850	550 — 875
Average vapor	480	500	450
Fuel oil burned	276 gals.	155 gals.	243.7 gals.

Redistillation of 7500 C. C. of the Distillate on Fractionating Still.

Naphtha to 375	57.68% — 61.8 gr.	43.03% — 61.2 gr.	45.28% — 60.5 gr.
Bottoms above 375	40.05%	53.97% — 37.6 gr.	50.33% — 37.3 gr.
Naphtha in gases absorbed	1.29%	1.68%	2.53%
Loss distilling	1.18%	1.31%	1.86%

The Yield of Products by Volume on Basis of Volume of Oil Used.

Naphtha to 375	16.66%	32.12%	21.71%
Bottoms above 375	11.51%	40.29%	24.13%
Naphtha from absorp. of gas	0.37%	1.25%	1.21%
Still bottoms	67.26%	25.35%	45.34%
Gas—calculated to oil.	2.00%	3.80%	3.80%
Loss distilling	0.34%	0.99%	0.89%
Other losses, leakage, etc.	1.86%	?	3.12%

4683 Tests on Products—Rune No. 6.

	Distillate	Bottoms Above 375	Still Bottoms	Naphtha to 375
Gravity	50.9	38.8	35.4	60.1
Flash-Cleve.	.....	.....	160	.....
Fire	.....	.....	210	.....
Viscosity	.....	.....	31/100	.....
Pour	.....	.....	0	.....
Maumene	.....	.....	.....	60
Olefin %	.....	.....	.....	20
Distillation	200 cc	100 cc	200 cc	100 cc
Start	121	428	316	120
10%	208 — 73.5	444	446 — 44.2	170
20%	251 — 65.4	448	474 — 40.0	200
30%	290 — 58.8	452	492 — 38.0	224
40%	327 — 53.7	456	508 — 36.9	242
50%	366 — 15.3	464	518 — 36.8	260
60%	394 — 46.3	478	536 — 36.2	278
70%	431 — 43.3	494	554 — 35.2	300
80%	462 — 41.0	510	577 — 34.3	322
90%	501 — 39.1	530	614 — 32.4	344
95%	548	550	700	366
E.P.	.....	574	.....	382
% Rec.	.....	98.0	.....	97.7

Tests on Products—Run No. 7.

Gravity	47.5	37.5	30.5	59.1
Flash-Cleve	—60	.....	145	.....
Fire	—60	.....	200	.....
Viscosity	26/100	.....	36/100	.....
Pour	0	.....	0	.....
Maumene	.....	.....	.....	52
Olefin %	.....	.....	.....	21.0
Distillation	200 cc	100 cc	200 cc	100 cc
Start	130	400	294	126
10%	234 — 69.1	432	456 — 43.0	174
20%	288 — 60.2	442	486 — 38.8	207
30%	334 — 54.6	450	510 — 36.8	230
40%	376 — 48.9	460	526 — 35.7	250
50%	416 — 45.0	470	540 — 34.6	268
60%	444 — 42.2	486	564 — 33.5	288
70%	468 — 39.7	498	580 — 32.5	305
80%	492 — 38.3	518	612 — 30.6	326
90%	526 — 36.7	544	680 — 26.4	354
95%	562	574	.....	373
E.P.	590	612	.....	388
% Rec.	98.0	98.0	.....	.....

4684 Tests on Products—Run No. 8.

	Distillate	Bottoms Above 375	Still Bottoms	Naphtha to 375
Gravity	37.3	37.6	33.3	60.5
Flash-Cleve	.....	185	130	.....
Fire	.....	210	195	.....
Viscosity	.....	33/100	36/100	.....
Pour	.....	0	0	.....
Maumene	.....	.....	.....	58.5
Olefin %	.....	.....	.....	16.0
Distillation	200 cc	200 cc	200 cc	100 cc
Start	124	404	340	112
10%	214 — 72.7	428 — 41.0	444 — 42.8	158
20%	266 — 64.6	432 — 40.4	476 — 39.6	192
30%	320 — 56.3	442 — 39.7	500 — 37.6	216
40%	356 — 50.4	452 — 39.0	520 — 36.4	236
50%	402 — 44.7	454 — 38.3	530 — 35.6	256
60%	434 — 41.1	478 — 37.5	542 — 34.8	276
70%	464 — 39.2	490 — 36.8	562 — 33.8	296
80%	488 — 37.6	508 — 36.0	596 — 32.1	316
90%	530 — 35.8	530 — 35.1	650 — 29.4	342
95%	.....	552	.....	362
E.P.	574	604 — 32.8	.....	388
% Rec.	95	98	90	97.7

The position of the thermometers on the coils; all are in the front. Number 1 is at the start of coil 2, number 2 is at the end of coil 3, number three is at the beginning of coil 6, number 4 at the beginning of coil 10, number 5 at the beginning of coil 14.

The pyrometers are placed as follows:—Pyrometer number 1 between first and second row of tubes and first and

second baffle in front part of furnace. Number 2 between arch and first baffle front of furnace; number 3 between arch and first baffle in middle of furnace; number 4 between arch and first baffle in back of furnace; number 5 between first and second row of tubes and first and second baffle in rear of furnace.

Remarks on Run No. 6.

The run was discontinued because of leakage.

The valve in the tar line, and the union on vapor line next to water box were leaking very much during the entire run.

The head on manhole, to large drum, would flash whenever the pressure was maintained much above 200 pounds.

Only the tower tubes were carbonized and these contained a thin scale on the bottom. The drum contained little or no carbon.

4685 Remarks on Run No. 7.

The run was discontinued because of excess leakage around the copper gasket in head to drum, and around the riveted joint of manhole on drum.

The two lower tubes contained considerable carbon on bottom of tubes.

Remarks on Run No. 8.

The run was discontinued on account of leakage.

You will note that on all of these runs considerable trouble was experienced on account of leakage. The apparatus is now undergoing repairs and we hope to have it in such shape before making the next run that a closing down will not be necessary, due to the leakage as has heretofore been the case.

Very truly yours,

Signed: J. G. Detwiler.

JGD-CHJ

RCH

4693 DX 761.

The Texas Company

New York, N. Y., January 30, 1918.

Patents.

Holmes Gasoline Process.

Personal

Mr. F. T. Manley,
Houston, Texas.

Dear Sir:

You have copy of Donaldson's letter to me of January 22nd.

While ordinarily I would think Donaldson's communication somewhat out of order and a matter which he might better have discussed with you verbally, still there is value in the point which he mentions, and it probably comes from our talk in Houston where I suggested it might be well to take the patents out in the names of Holmes, Manley, and Behimer.

My principal concern in the matter is in our securing valid patents to these inventions, so that we have the exclusive right to use them, except as we might license others to use, and further that there be the minimum amount of complications in accomplishing this.

After thinking the matter over on the way up, I thought it would be undesirable to establish a precedent of including those who might be working on the propositions that we set them about, for the reason that there might be a number of such assigned to different research work.

I have since, however, talked to Judge Beaty and he is
of the opinion that it might be less difficult to secure
4694 and protect these patents if taken out in the name
of all those who may in any way be contributing to the ideas as they may be finally covered in the patent applications, and for this reason I would be glad if you would see Donaldson at once and have the patents drawn up in this way, which will probably be a little more pleasing to Behimer, and I am anxious to do whatever is pos-

sible to stimulate the best efforts from him or any others doing research work.

I do not have in mind that these patents to be taken out in three names are to cover your idea, or your invention or discovery, of manufacturing gasoline by pumping oil of low boiling point fractions into any other oil or substance of higher boiling point fractions. This I understand is strictly your idea and the patent should be in your name alone.

The idea that I claim original thought and work on is the vertical still, particularly the vertical still in continuous distillation, whether it be for operation in connection with your process or the process of straight pressure distillation free from the idea you have of charging one oil into another;

The advantages of this equipment and this process being:

In maintaining at all times a maximum amount of heating surface;

4695 Avoiding the exposure of any part of the still surface to heat not covered by oil or otherwise avoiding heating the vapor space in the still; and

The use of higher pressures in commercial sizes of equipment, which would be difficult, if not impossible, where the stills are not so constructed as is the vertical still and provided with the necessary scraping or cleaning arrangements.

A further point which should not be overlooked, among many others which you of course already have in mind, is the quality of the product produced.

It produces a gasoline without question of higher percentages of saturated hydrocarbons than the Burton or other combination liquid and vapor phase stills.

The other patent that I have in mind is the one using the high pressure coil, which I outlined originally to Dr. Gray and he in turn turned the work over to Behimer, my thought at that time being that we could subject this oil to the necessary temperature and pressure in the coil and accomplish the distillation in stills connected to the coil, but under lower pressure, and we have been more or less successful in these tests.

In this as well as the vertical still pressure process you and Behimer have contributed suggestions as the experimenting has progressed, and I am very anxious now that we apply for patents without further delay

both on the processes and the equipments to the fullest extent that we can find consistent to do so, carefully
4696 studying other patents to avoid infringement, but covering fully all of the ideas both in processes and equipment that can be in any way new and have value to us.

I would appreciate very much your prompt attention to these matters, and think it would be entirely in order for you to drop all other work for a week or ten days, or whatever time is necessary to go thoroughly into the matter with Donaldson and Behimer or others who may be of assistance, and get the papers up here with the least possible delay.

In this connection will you wire me as quickly as possible the percentage of unsaturated hydrocarbons in the samples of gasoline now being produced on these vertical still experiments? It would be of advantage to me if this would show on each of the tests that follow.

I would feel that we had been inexcusably negligent if some one else should put in some sort of an application along these lines while we have been neglecting to do so, and in order to substantiate our position I wish you would have some one there look thoroughly clear back through all my old files, Dr. Gray's, yours, and Hull's and send to me a copy of every reference to these experiments from the beginning.

4697 The first reference, so far as the coil work was concerned, was back long before Dr. Gray left us; soon after, I think, my first conversation with Cross, which came up through an attorney in Kansas City by the name of Metcalf, the negotiations, I believe, starting through Lambert at Port Arthur.

The 200-pound pressure or the vertical still construction started in my original outline of the continuous tubular vertical stills, which I instructed should be built for an operating pressure of 200 pounds.

I would appreciate it very much if you would put some one on this who will gather up all the data as directed and send me the copies with as little delay as possible, at the same time keeping those files there intact and in good order.

Very truly yours,

R. C. Holmes.

RCH-LAG

4698 DX 762.

Telegram

(Do Not Use Wires for Business That Can Wait for the Mails)

New York, N. Y. February 6, 1918.

F. T. Manley
Houston, Texas.

Proceed on instructions my letter January 30, patents, and wire me how quickly both applications will be sent on here.

R. C. Holmes

RCH-ASA

Manley:

There has been so much opportunity for people to know what we are doing and plenty of time for them to make applications, etc., so that it would not be at all surprising if someone anticipated us in the application.

I am asking you to handle the matter for the reason that I am practically helpless here to handle the matter alone; Donaldson, the Engineering Department, and everyone else there being at your service in putting the matter through.

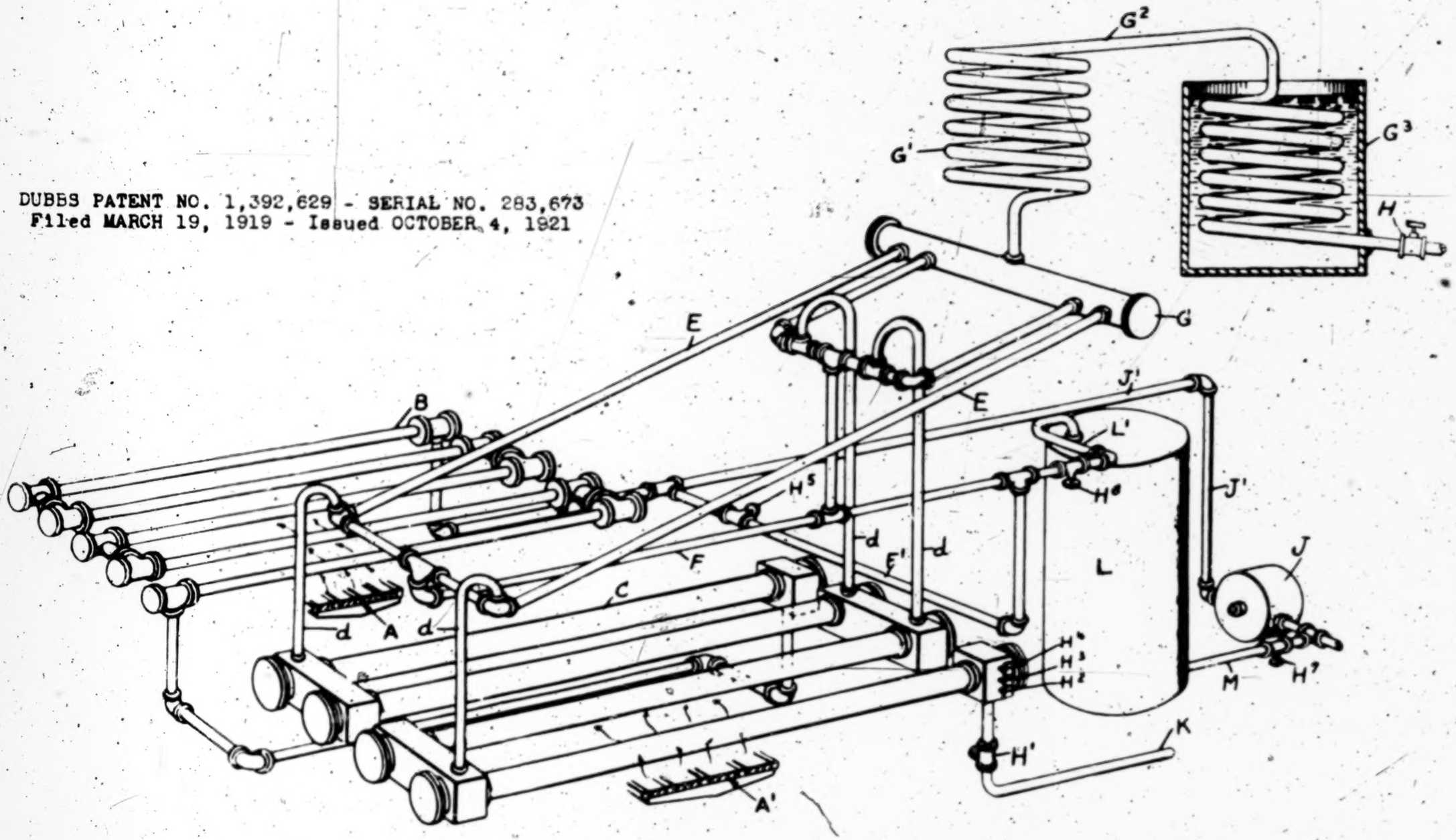
Page 2

My judgment is that there is not an idea in either of these patents that I am talking about that I have not discussed with you and Dr. Gray. The mistake has been made in not putting everything in writing particularly on account of the extreme difficulty I have in getting anyone to work on these matters and avoid so much unnecessary and really inexcusable delay, everyone forgetting in the meantime what they have been asked to do. However, proceed along the line of my letter to you of January 30—if necessary letting other work go for a time.

R. C. H.

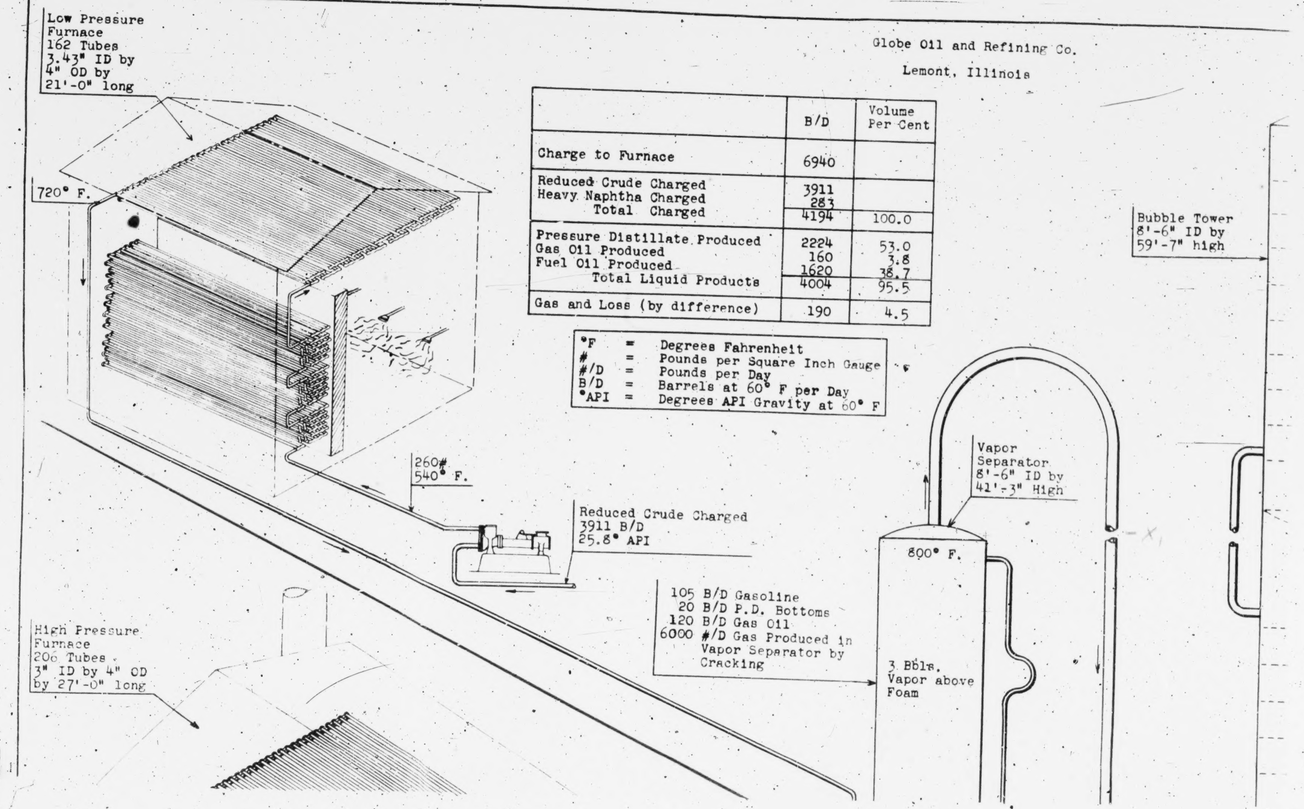
EX 773

DUBBS PATENT NO. 1,392,629 - SERIAL NO. 283,673
Filed MARCH 19, 1919 - Issued OCTOBER 4, 1921



Globe Oil and Refining Co.

Lemont, Illinois



	B/D	Volume Per Cent
Charge to Furnace	6940	
Reduced Crude Charged	3911	
Heavy Naphtha Charged	283	
Total Charged	4194	100.0
Pressure Distillate Produced	2224	53.0
Gas Oil Produced	160	3.8
Fuel Oil Produced	1620	38.7
Total Liquid Products	4004	95.5
Gas and Loss (by difference)	190	4.5

°F	=	Degrees Fahrenheit
#	=	Pounds per Square Inch Gauge
#/D	=	Pounds per Day
B/D	=	Barrels at 60° F per Day
°API	=	Degrees API Gravity at 60° F

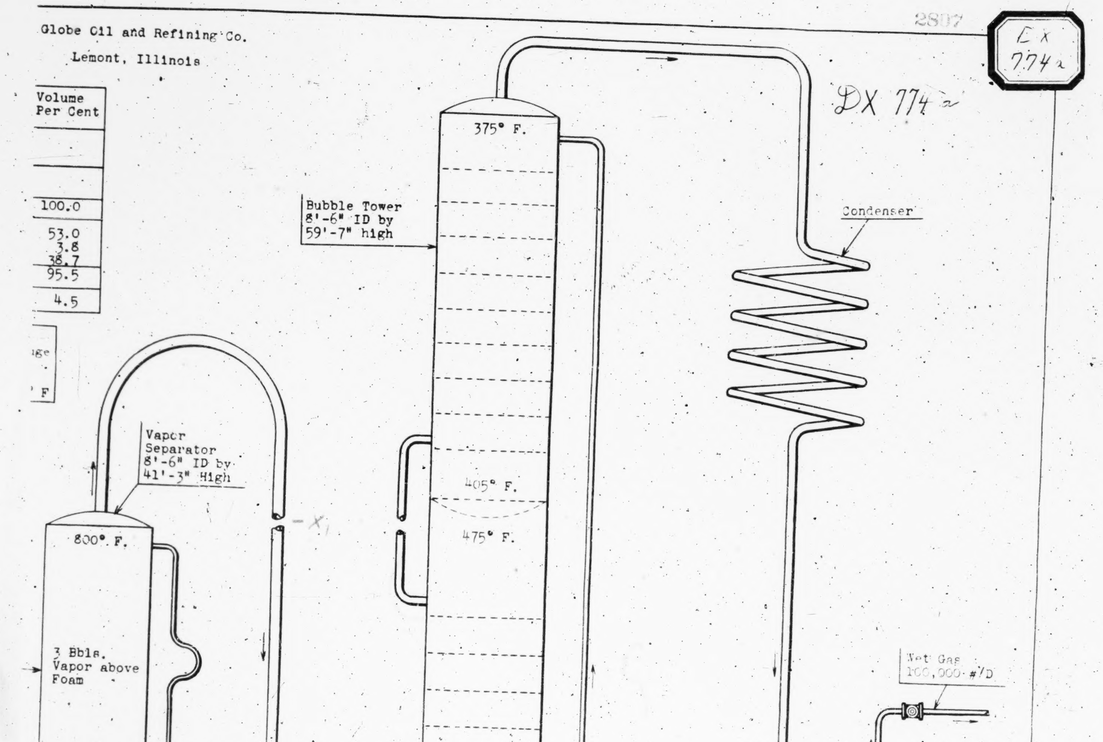
2807

Globe Oil and Refining Co.

Lemont, Illinois

DX 774 a

Ex 774 a



206 Tubes
3" ID by 4". OD
by 27'-0" long

725° F.

665° F.

660#

910° F.
10% by weight
Vapor
30% of Space
Occupied by Vapor

500# - 940° F.
85% by weight
Vapor
95% of Space Occupied
by Vapor
1755 B/D Gasoline
(94% of Total)

Vapor above
Foam

26#

B

16 Bbls.
Liquid
1 Bbl. Vapor
in Foam

805°F.

Fuel Oil
1620 B/D
10.1° API

Cooler

Total Charge
to Furnace
6940 B/D
23.1° API

Heav
283
45.2

Foam

26#

16 Bbls.
Liquid
1 Bbl. Vapor
in Foam

805°F.

24#

595°F.

Gas
Separator
5'-0" ID
by 30'-0"
High

15#

Pressure Distillate
2224 B/D
54.6° API
1860 B/D Gasoline
Content

Cooler

Gas Oil
160 B/D
22.2° API

oler

Total Charge
to Furnace
6940 B/D
23.1° API

Heavy Naphtha
283 B/D
45.2° API

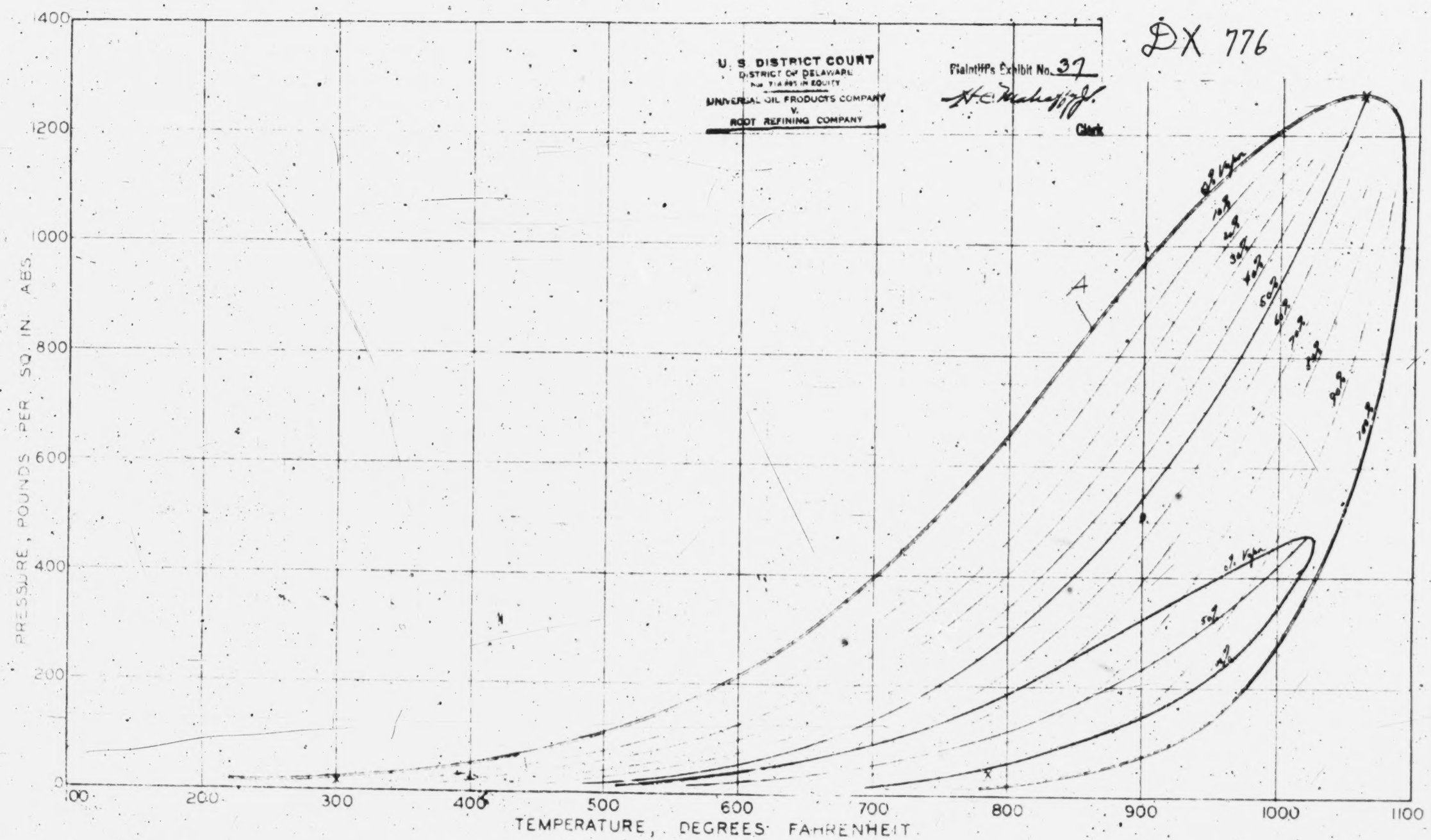
A

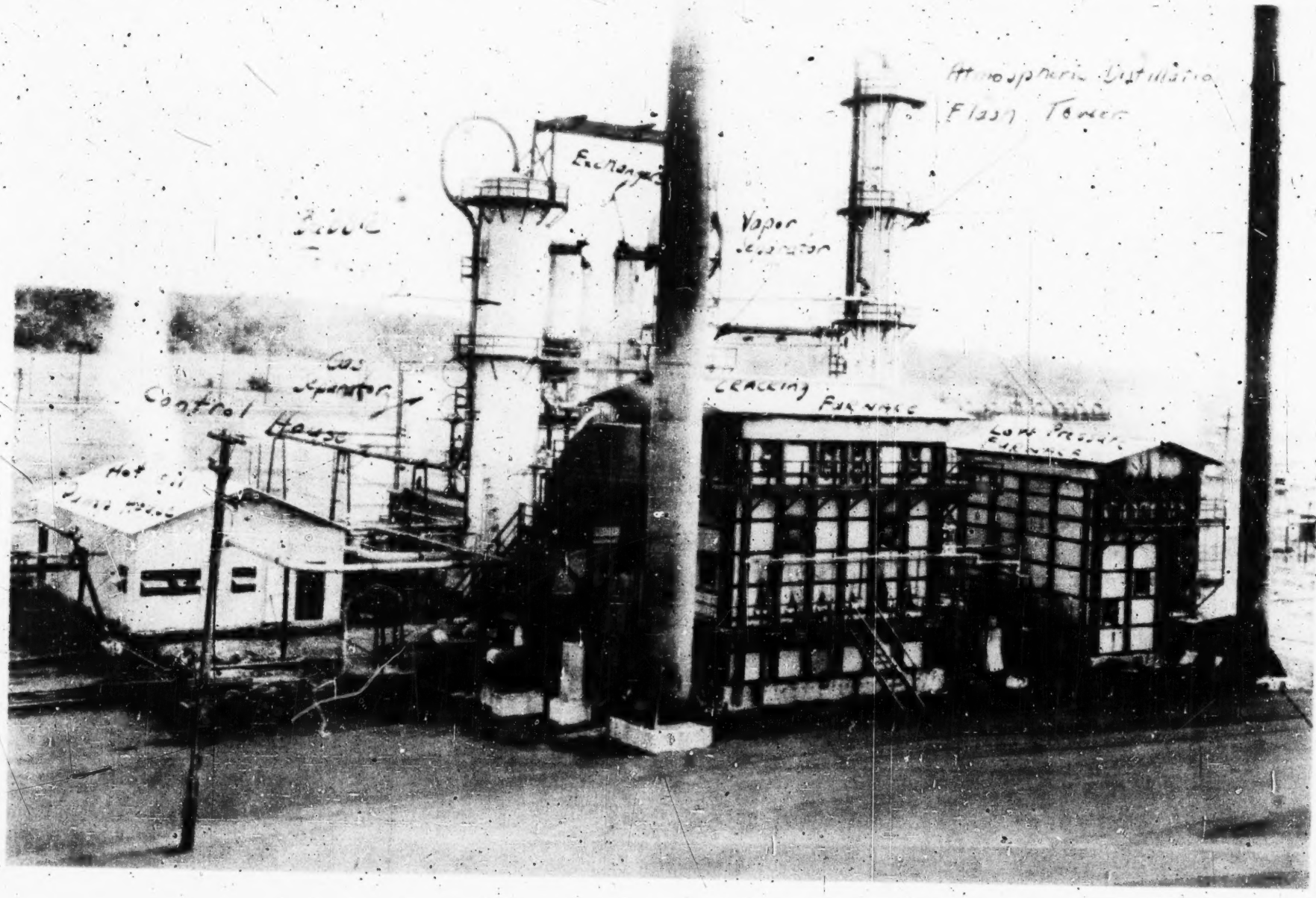
* X 775

DX 776

U. S DISTRICT COURT
DISTRICT OF DELAWARE
No. 716 IN EQUITY
UNIVERSAL OIL PRODUCTS COMPANY
V.
ROOT REFINING COMPANY

Plaintiff's Exhibit No. 37
H. E. Mahaffy Jr.
Clerk

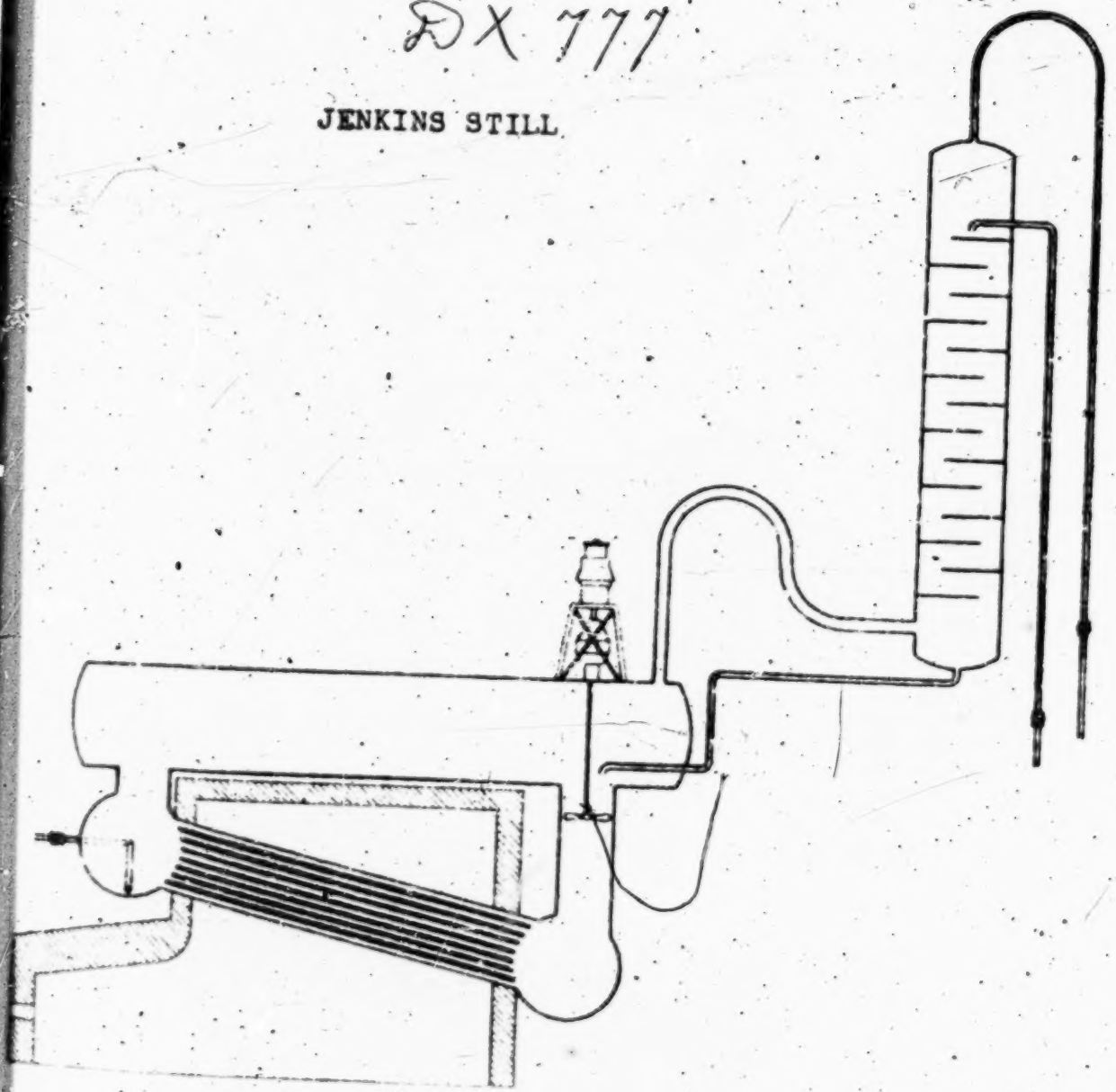


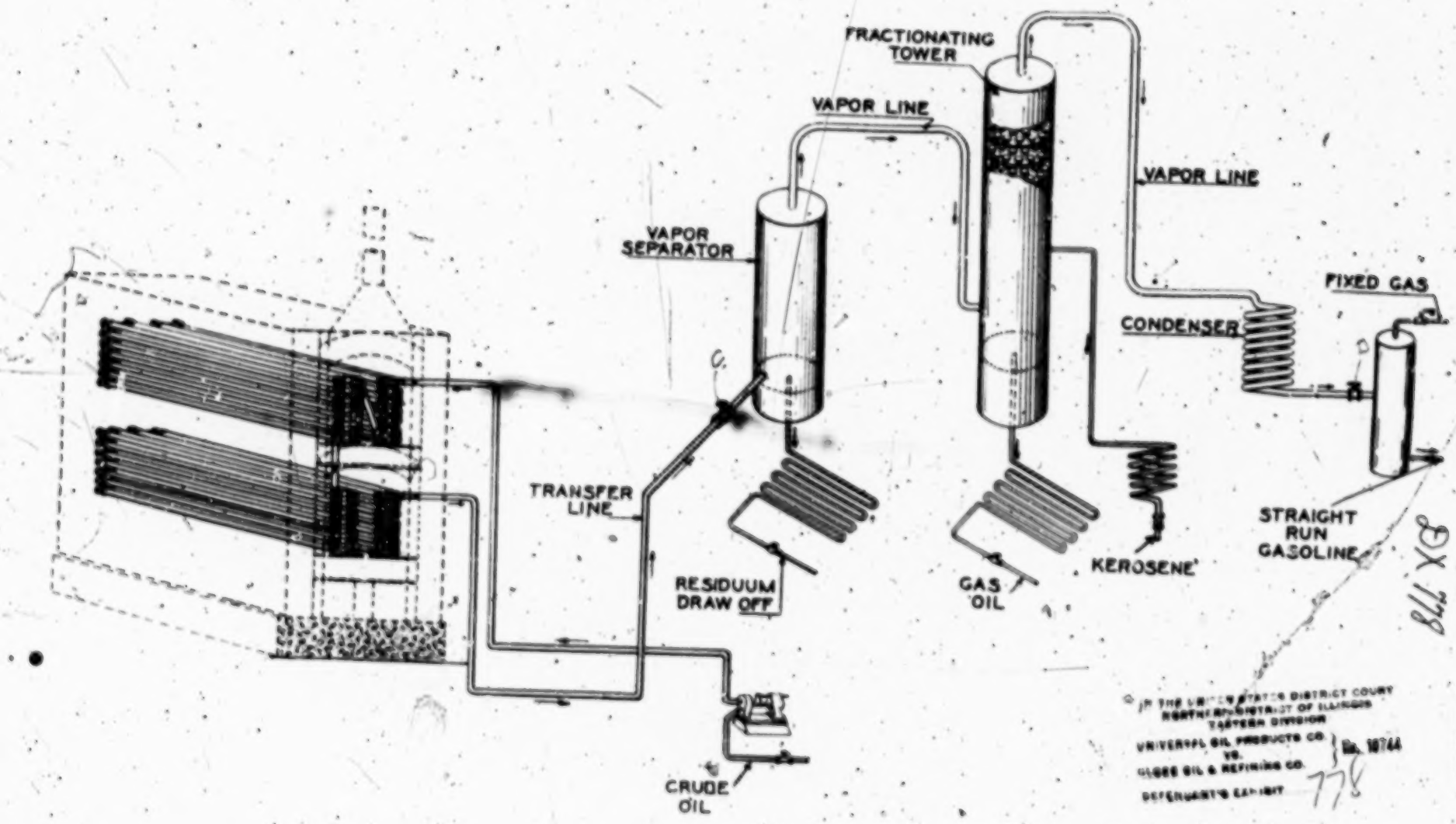

Atmospheric Distillation
Flash Tower
Exchanger
Vapor
Gas
Control House
Cracking
Low Pressure

6082

DX 777

JENKINS STILL





IN THE UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION
UNIVERSAL OIL PRODUCTS CO.
vs.
GLOBE OIL & REFINING CO.
DEFENDANT'S EXHIBIT 778
No. 18744

DX 778

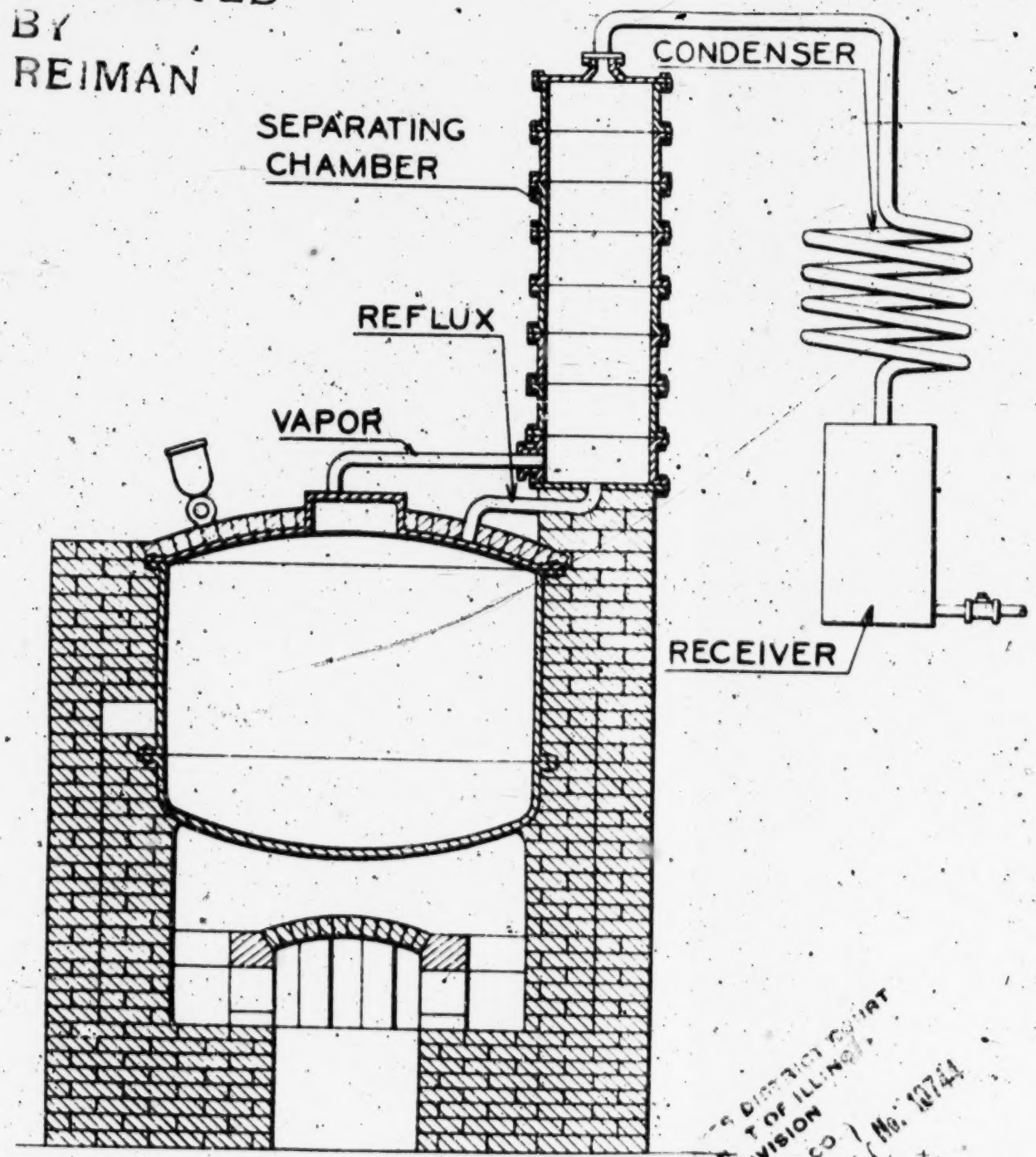
2815

ATWOOD PAT. NO. 28,448
PATENTED MAY 29, 1860

DX 780

2817

AS INTERPRETED
BY
L.R. REIMAN

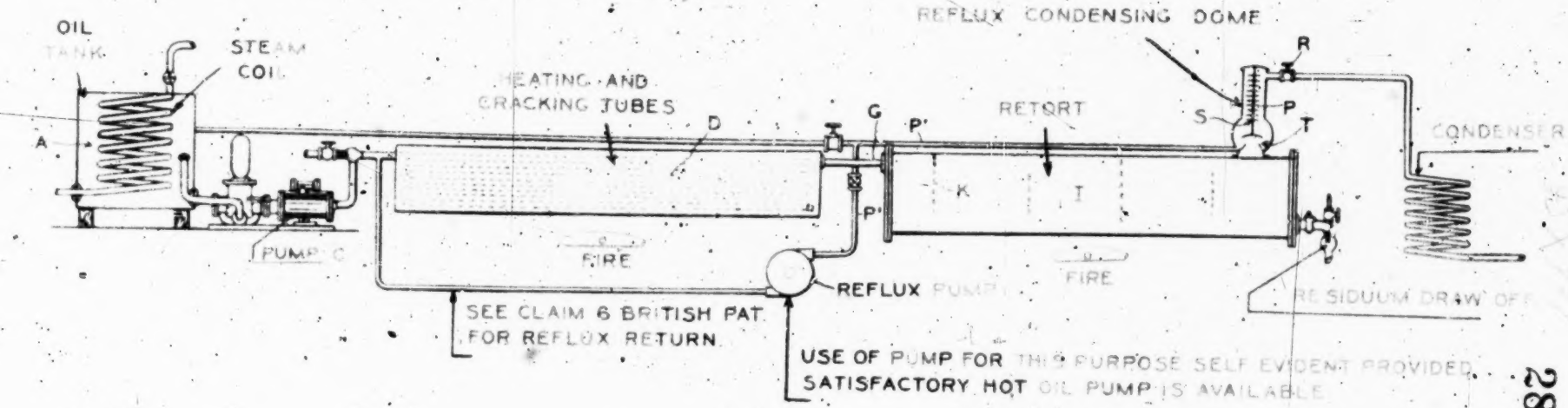


...DISTRICT COURT
...T OF ILLINOIS
...DIVISION
...PRODUCTS CO.
V2
...REFINING CO.
No. 1744

AS INTERPRETED
BY
DR. REIMAN

PIELSTICKER U.S. PAT. NO. 477,153 (1892)
BRITISH PAT. NO. 1308 (1891)

IN THE UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION
UNIVERSAL OIL PRODUCTS CO.
VS
GLOBE OIL & REFINING CO.
DEFENDANT'S EXHIBIT



2819

4707 DX 794.

Port Arthur, Tex., Sept. 21st, 1917.

Mr. R. G. Dawson,
Houston, Texas.

Dear Sir:

Would be pleased to have you secure for us at your earliest convenience quotations and drawings on high pressure experimental stills as follows:

1—4 ft. dia. x 20 ft. designed for 300 lbs. pres.
1— Ditto 500 " "
1—5 ft. dia. x 20 ft. designed for 300 " "
1— Ditto 500 " "

Very truly yours,

RCK-LJ

4708 DX 795.

The Texas Company

Houston, Texas, September 24, 1917.

Mr. A. S. Bailey,
Port Arthur, Texas.

Dear Sir:

I have your letter of September 21st asking me to secure quotations and drawings on high pressure experimental stills.

So far as we know, there are no manufacturers prepared to quote on special equipment of this character without drawings and specifications to be submitted by the purchaser.

It will therefore be necessary for me to have further information from you before quotations can be secured.

Yours truly,
Southern Purchasing Agent.

RGD-bdh
cc BEH

4709 DX 796A

Port Arthur, Tex., Oct. 6th, 1917.

Mr. R. G. Dawson,
Houston, Texas.

Dear Sir:

Referring to our letter of Sept. 21st, and your reply of Sept. 24th. Please obtain quotations on a 4′ x 20′ high pressure still with all the trimmings as shown on our drawing No. U-2212, prints attached. Still to be of soft steel, still bottom quality, and all seams to be made by the forge and hammer welding process. Still to withstand a working pressure of 500 lbs. per sq. in.

Very truly yours,

RCK-LJ

2823

IN THE UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION
UNIVERSAL OIL PRODUCTS CO.
VS.
CLARK OIL & REFINING CO.
DEFENDANT'S EXHIBIT
No. 1014

BX 1964

Still Setting 55'0"

90'0" E. to c. Bldg. Cols.)

123'4"

Condenser Box - 2'

Coils - 25'0"

2'-0"

6'2"

42" Pumping Out Line

4" Runback Line from Air Condensers

4" Runback Line

4" E.H. Gate Valves

4" Flow Pipe

10" Vapor Pipe

10" Vapor Line

4" Overflow Line

4" Needle Valves

10" Vapor Lines

Drum

Drum Off Lines

Ball Check Valves

3" Gate Valves

Ball Check Valve

3" Charging Line

3" Gate Valves

4" Preheater By Pass & Circulating Line

3" Preheater Drain

3" Preheater Charge Line

2" Circulating Line

Battery No. 1

℄ of Preheater

PREHEATER

Breeching

4" Drum Off Line

Drum Off Line under Tracks

4" Overflow Line

Preheater & Circulating

Economizer Outlet

Tubular Cooler

Test Condenser from A

4" E.H. Pipe - Top

3" E.H. Pipe at both

Exchanger

4" Exchanger By Pass

3" Exchanger By Pass

3" Gate Valve

3" Economizer or Exchanger By Pass

3" Economizer Drain

3" Economizer

ECONOMIZER

4'6" Steel Walk

EXHIBIT

70'-0" (c. to c. Bldg. Cols.)

12'-4"

Condenser Bar - 29'-0"

Coils - 25'-0"

15'-0"

18'-0"

6'-2"

2'-0"

24" Pumping Out Line

4" Manlock Line from Air Condensers

10" Vapor Line

4" Overflow Line

Turntable

4" Needle Valves

Vapor Lines

4" Draw Off Line

Draw Off Line under Tracks

4" Overflow Line

4" Water Supply

2" Water Line

Test Condenser from Air Cond.

4" E.H. Pipe - Top

3" E.H. Pipe at bottom

Walk

2"-6" Steel Beam

6"x4"x6" Tee

2"-6" Overflow

4" Gas carry Off

4" Relief Valve Set at 200#

3" E.H. Line to Accumulators

Condenser Bar - 12'-0"

14'-0"

10'-0"

14'-0"

From Tank

6"x3"x6" Tee

6" Line

3" Line - Charging

4'-0"

Exchanger

4" Exchanger Drawoff Line

6'-0"

Preheater & Exchanger Drain to Pumps

5" Gate Valve

3" Exchanger By Pass

Down

3" Economizer or Exchanger By Pass

3" Economizer Drain

3" Economizer Charge Line

Damper Gears

Stack 5'6" Diam.

ECONOMIZER

Preheater & Circulating

Damper Gears

Economizer Outlet

4'-6" Steel Walk

Down

25'-0"

17'-0"

21'-3"

36'-0"

CONTROL HOUSE

Control Board

Venturi Meter

for Battery No.

2'6" Diam. x 5'-0" Accumulator

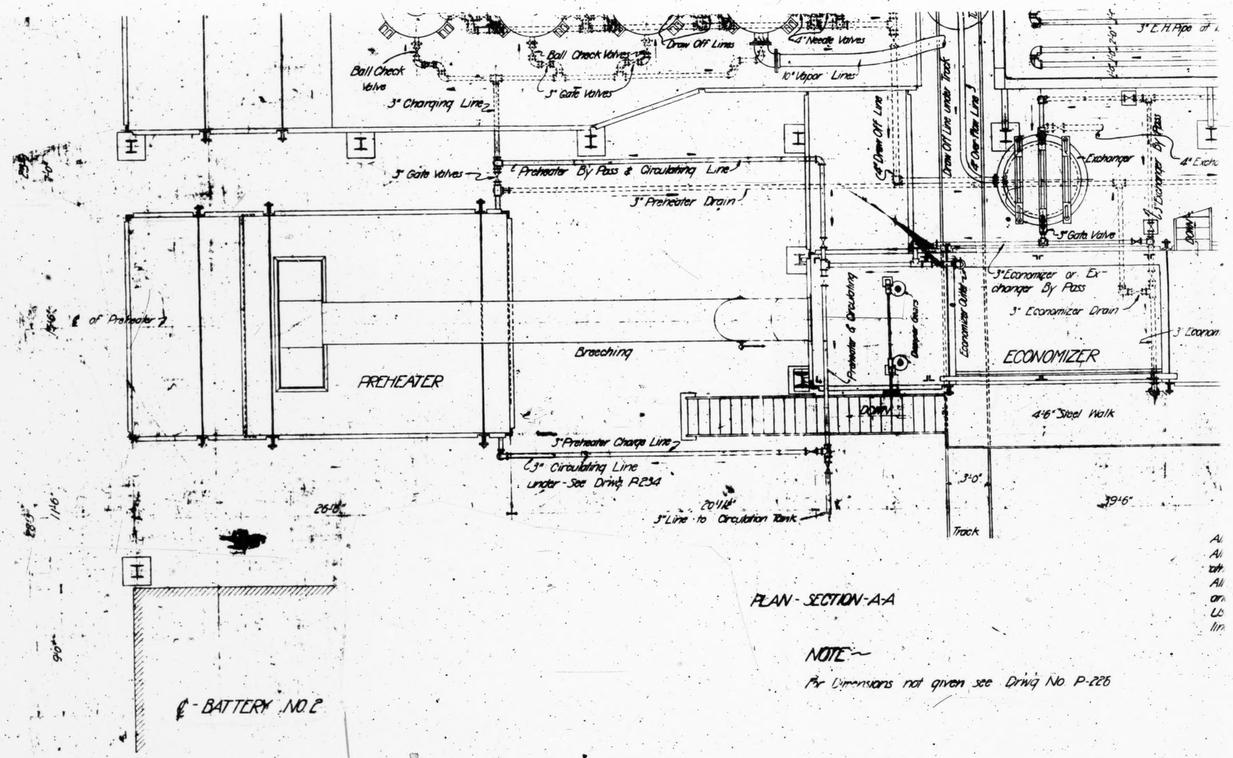
to Accumulator Tanks

Battery No. 2

Extra

17½" x 4½" x 10" Worthington Pumps

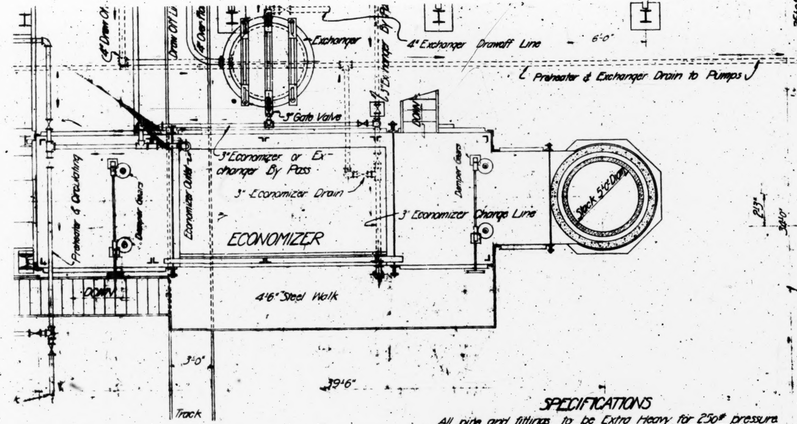
Pipe Trench



PLAN - SECTION - A-A

NOTE—

For Dimensions not given see Drwg No. P-226



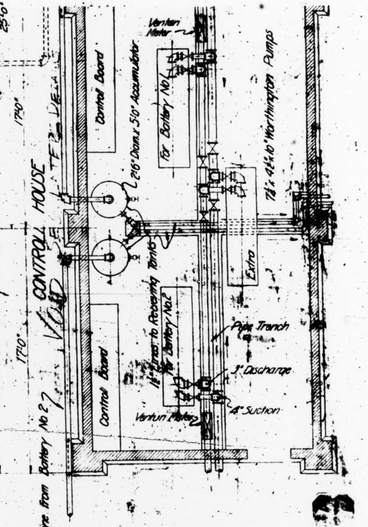
SECTION - A-A

NOTE—

For Dimensions not given see Drwg No. P-226

SPECIFICATIONS

All pipe and fittings to be Extra Heavy for 250# pressure.
All valves shown to be flanged gate valves unless otherwise noted.
All threaded connections to be set up with Lythorge and glycerine paste.
Use precaution when installing Runback and Drawoff lines to prevent traps.

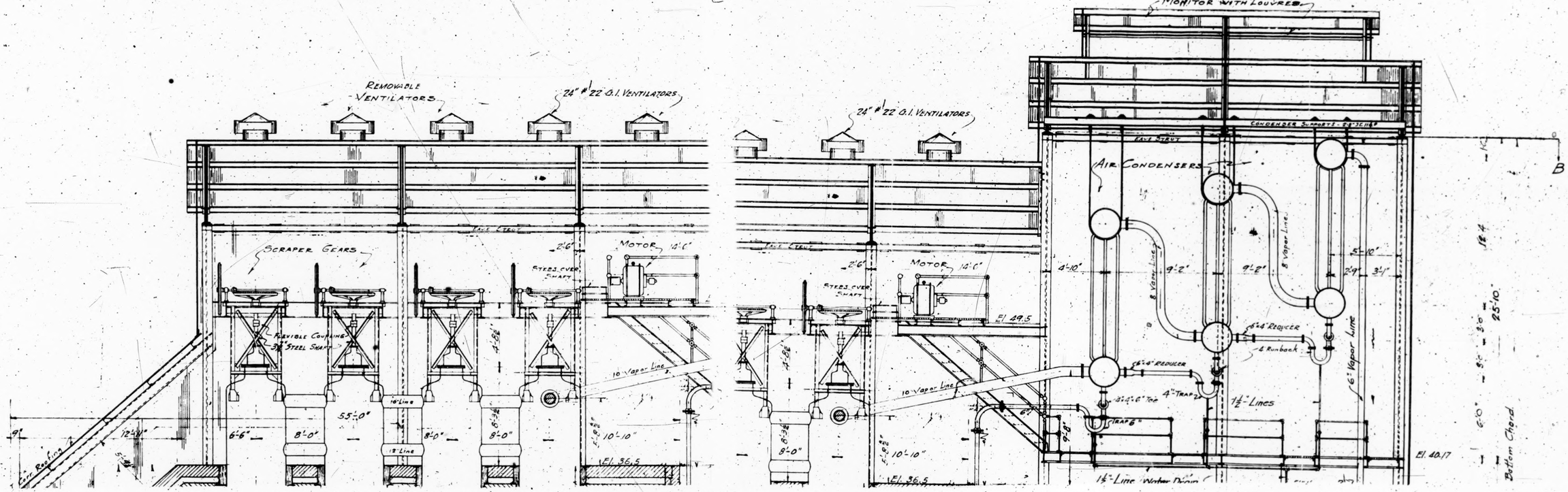


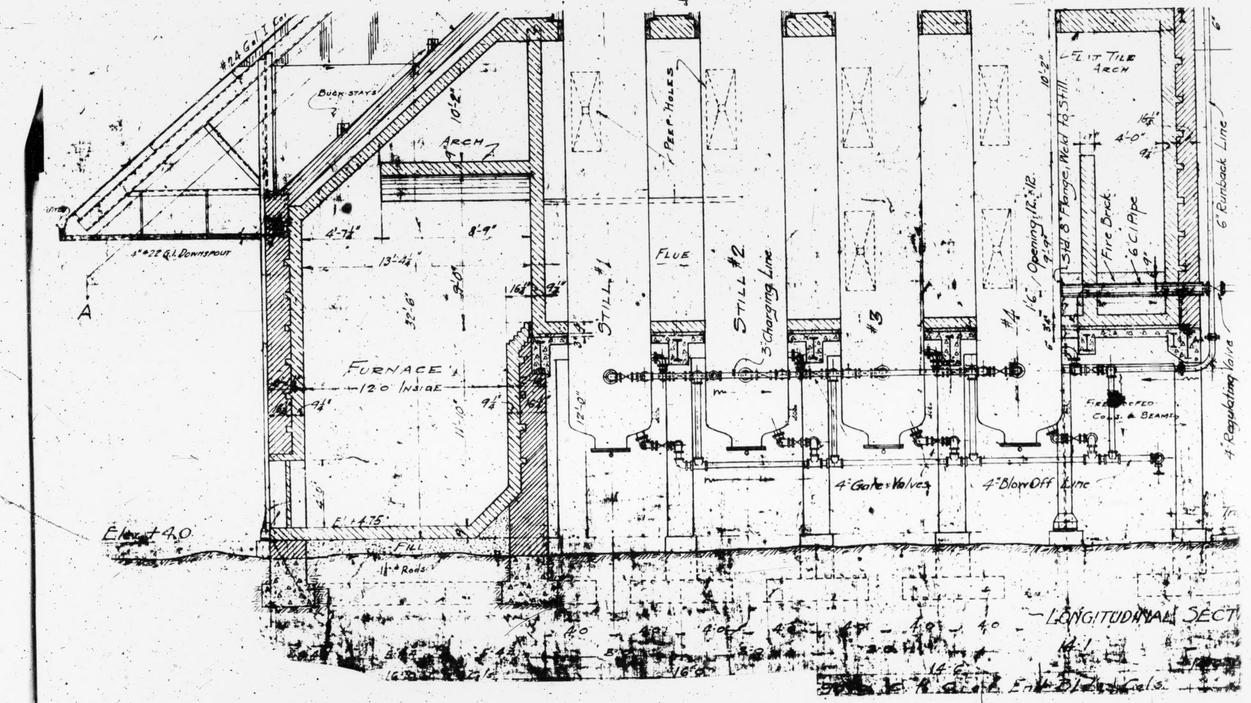
ESTIMATE NO.

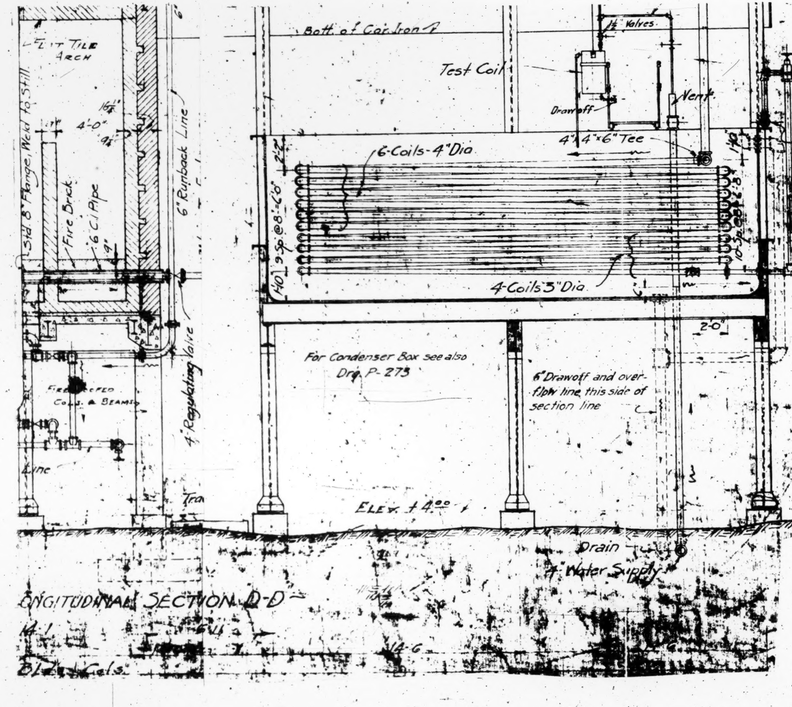
THE TEXAS COMP...
REFINING DEPARTMENT
HOUSTON, TEXAS.

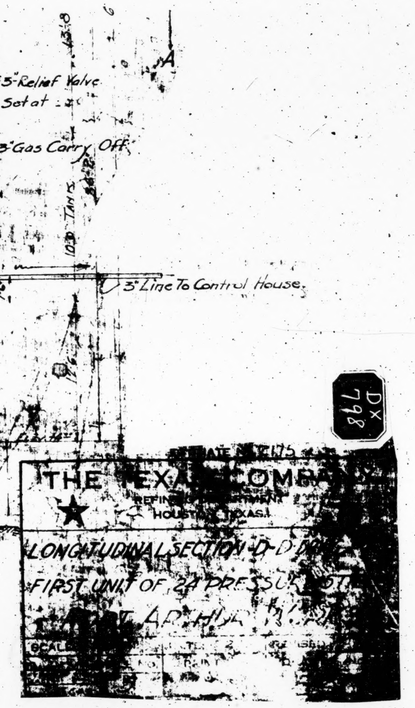
PLAN SECTION A-A DRWG. P-280
FIRST UNIT OF 24 PRESSURE STILLS
PORT ARTHUR WORKS

SCALE: 1" = 1 foot	DATE: 6-5-	RECORD NO.
FILE NO.	PRINT NO.	
583038		

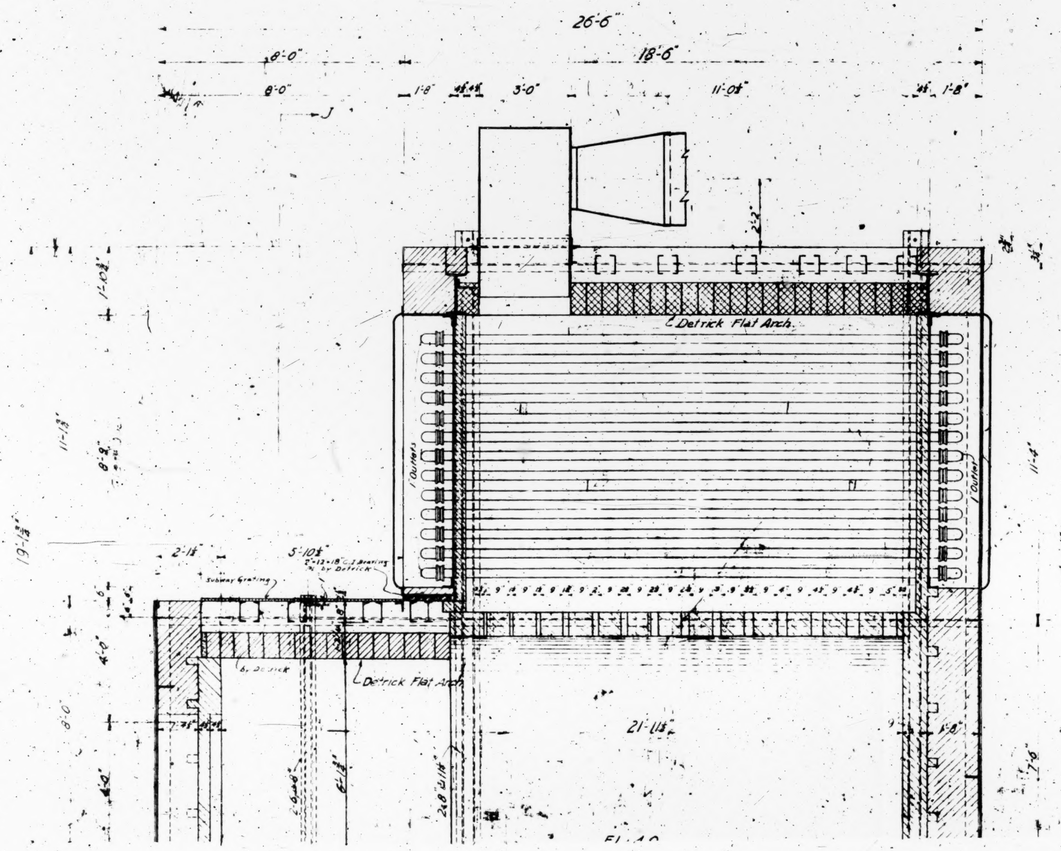

Removable Ventilators
24" #22 G.I. Ventilators
Scraper Gears
Motor 14'-0"
Steps over Shaft
Flexible Coupling
3½" Steel Shaft
10 Vapor Line
10" Line
12" Line
55'-0"
6'-6"
8'-0"
8'-0"
8'-0"
10'-10"
El. 36.5
Corr. Roofing
Monitor with Louvres
Condenser Supports - 6"x 3" I Beams
Air Condensers
8 Vapor Line
9'-2"
4'-10"
5'-10"
6"x4" Reducer
4 Runback
6" Vapor Line
4" Trap
1½" Lines
Trap 6"
1½" Line
El. 49.5
El. 40.17
Bottom Chord
25'-10"
6'-0"
8'-3"
18'-4"
A
B

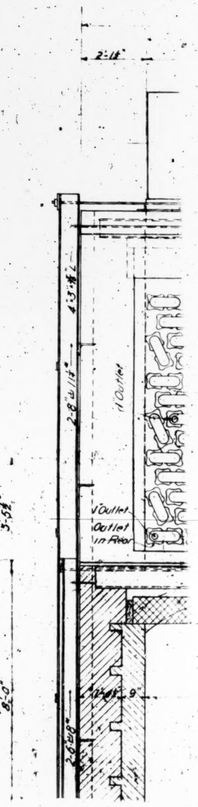

#28 G.I.T. Co.
Buck Stays
ARCH
5"-2E G.I. Downspout
A
4'-7½"
8'-9"
13'-4½"
3'-6"
4'-0"
16½"
12"
FURNACE
120 INSIDE
9½"
11'-0"
12'-0"
STILL #1
FLUE
PEEP HOLES
STILL #2
3" Charging Line
#3
#4
16" Openings 12'-0" c.c.
6"-3½"
3/16" Stl. 8' Flange, Weld to Still
Fire Brick
6" C.I. Pipe
4'-0"
9½"
L.T. Tile Arch
6" Runback Line
4" Regulating Valve
Fire Proofed Cols. & Beams
4" Gate Valves
4" Blow Off Line
Elev. 40
Fill
11" Rods
LONGITUDINAL SECTION

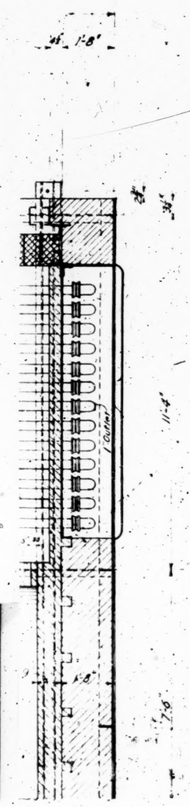

L.T. Tile Arch
3/16" Stl. 8' Flange, Weld to Still
Fire Brick
6" C.I. Pipe
6" Runback Line
4" Regulating Valve
Fire Proofed Cols. & Beams
Line
Tra
Batt. of Cast Iron
½" Valves
Test Coil
Vent
Drawoff
4"-4"-6" Tee
6-Coils-4" Dia.
40-1 3/8" O.D. Tubes 10'-3" Long
4-Coils 3" Dia.
For Condenser Box see also Drg. P-273
6" Drawoff and overflow line this side of section line
Elev. 140
Drain
Water Supply
LONGITUDINAL SECTION D-D

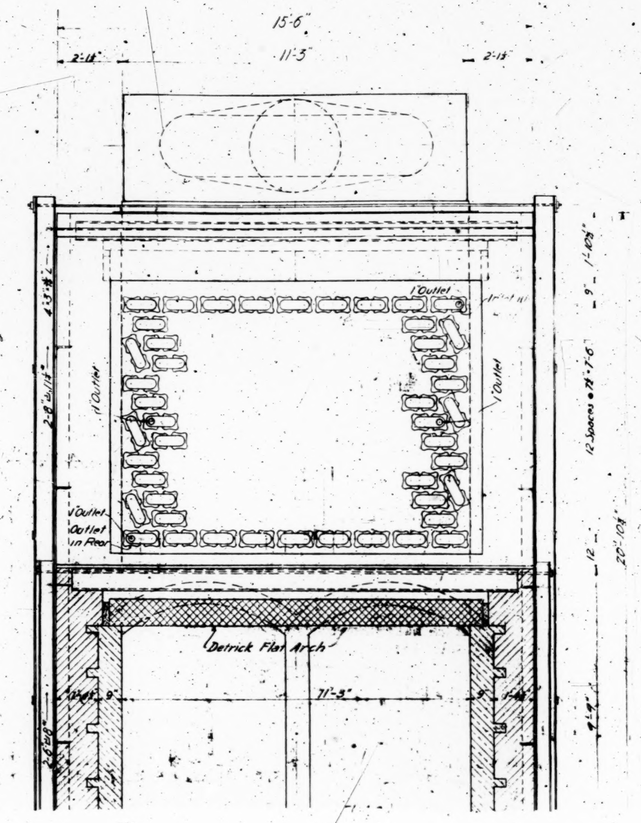

A
5" Relief Valve Set at
3" Gas Carry Off
3" Line To Control House
THE TEXAS COMPANY
HOUSTON, TEXAS
LONGITUDINAL SECTION D-D
FIRST UNIT OF 24 PRESSURE STILL
SCALE

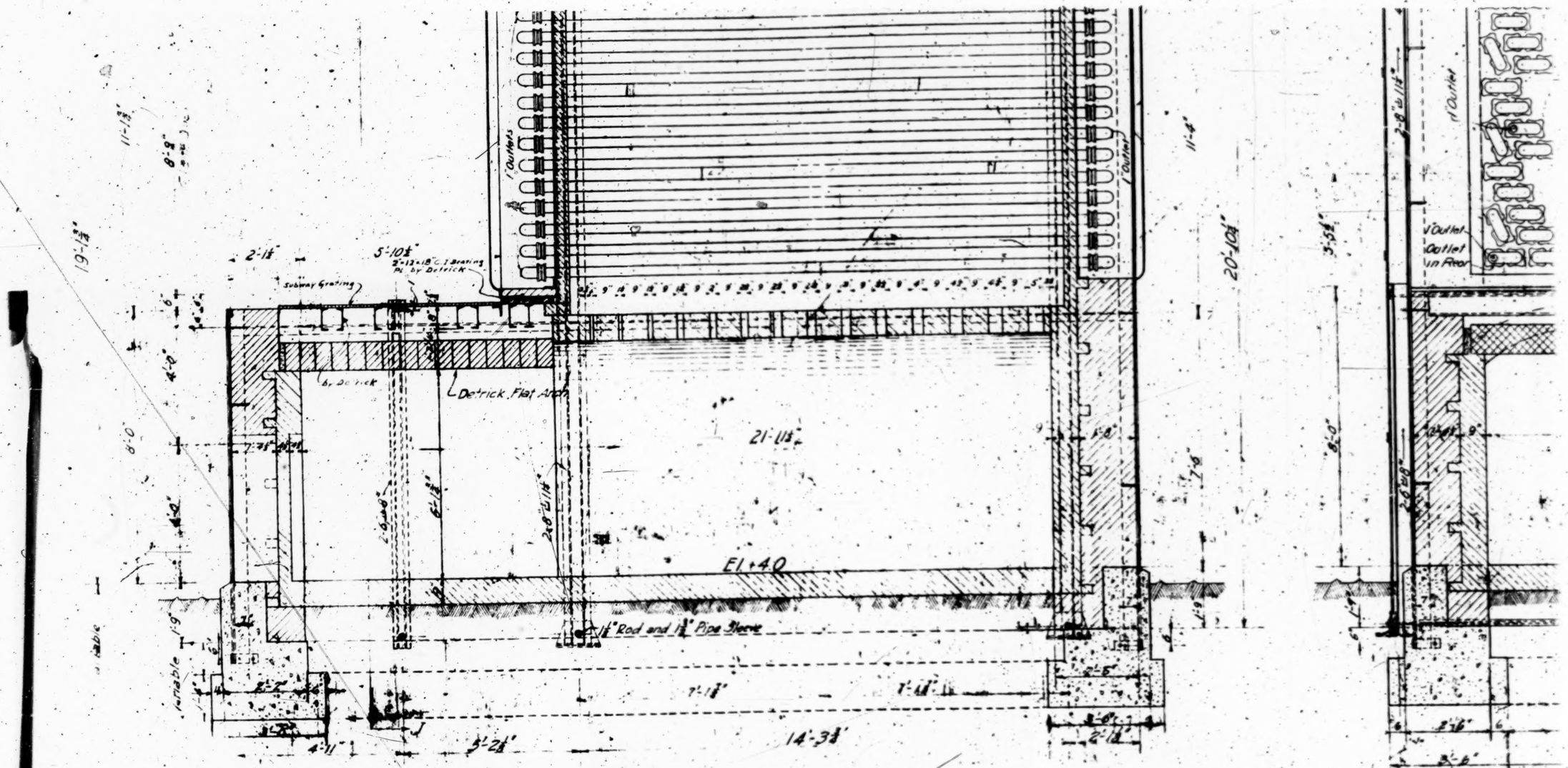
Dx 798

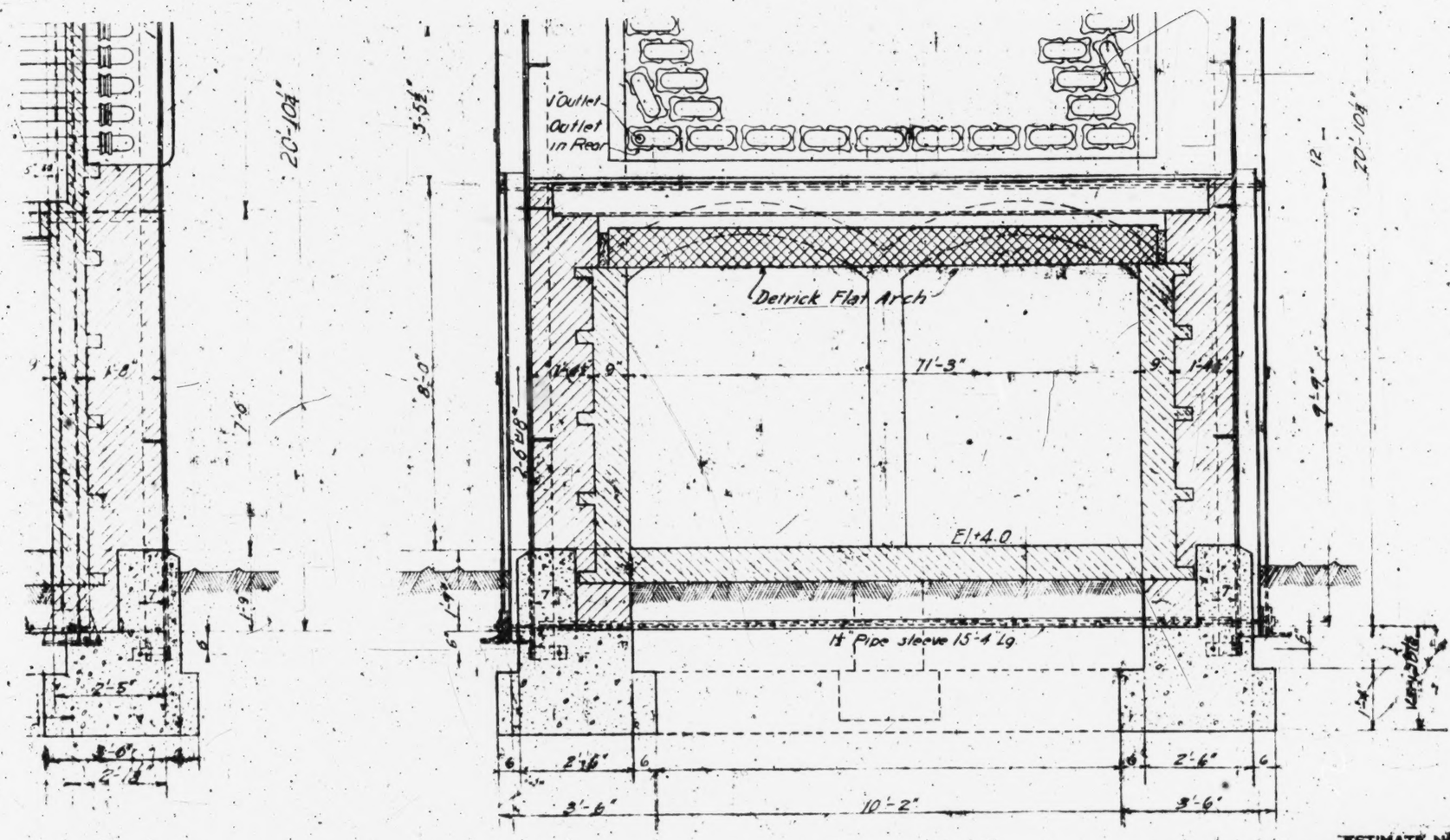

26'-6"
8'-0"
18'-6"
8'-0"
1'-8"
3'-0"
11'-0"
1'-8"
℄ Detrick Flat Arch
1 Outlet
1 Outlet
2'-1"
5'-10"
Detrick Flat Arch
21'-11"
20'-10"
11'-4"
8'-0"
4'-0"
2'-0"
1'-8"
3'-6"


2'-1"
1 Outlet
1 Outlet
1 Outlet
20'-10"
11'-4"
8'-0"
3'-5"


1'-8"
1 Outlet
20'-10"
11'-4"
8'-0"
3'-5"


15'-6"
2'-1"
11'-3"
2'-1"
1 Outlet
1 Outlet
1 Outlet
1 Outlet
Detrick Flat Arch
11'-3"
20'-10"
11'-4"
8'-0"
3'-5"


Subway Grating
Detrick Flat Arch
21'-11½"
El +40
1" Rod and 1½" Pipe Sleeve
7'-18"
7'-18"
14'-3½"
5'-2½"
4'-11"
2'-6"
2'-6"
2'-6



SECTION "J-J"
This Sheet

DX 699

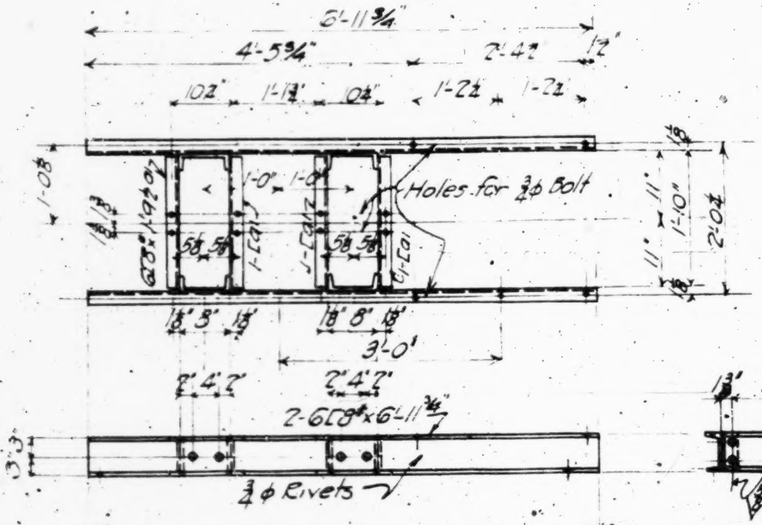
ESTIMATE NO. 2175

THE TEXAS COMPANY
REFINING DEPARTMENT
HOUSTON, TEXAS

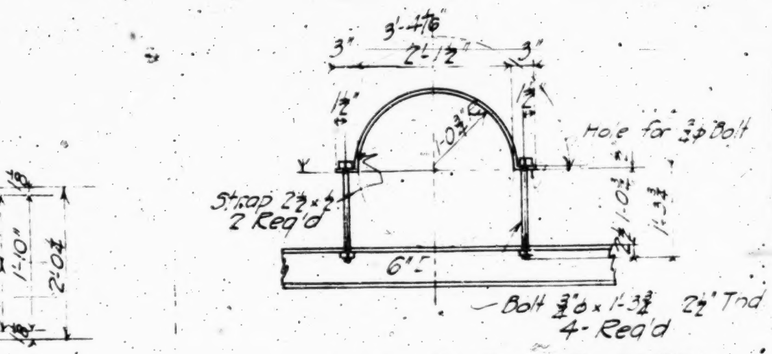
DETAILS OF PREHEATER
SECTIONS - TWIN ARCH DESIGN
FIRST UNIT OF 24 PRESSURE STILLS
PORT ARTHUR WORKS

Revised May 6-30

583062



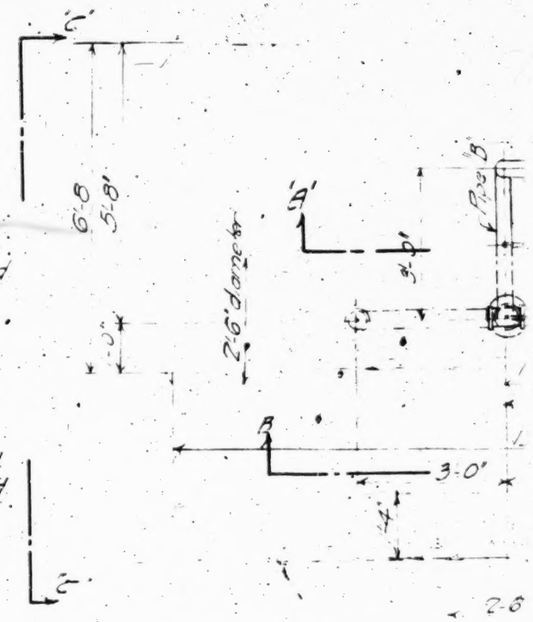
DETAIL OF FRAME W.O. F.1591
One- Required



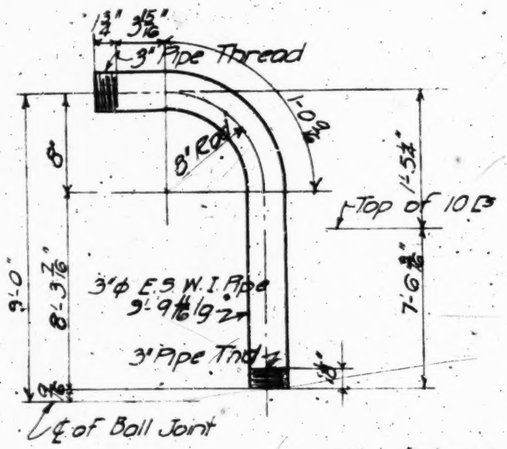
DETAIL OF FLOAT GUAGE TANK FASTENING W.O. F 1966

FIELD BOLTS FOR SUPPORTS

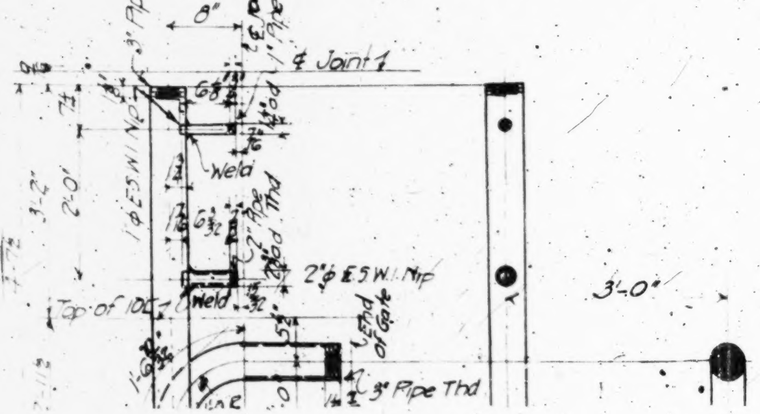
8- Bolts 3/4 ϕ x 0'-5 1/2 Hex - 2 1/2" Thd.
4- Bolts 5/8 ϕ x 0'-3" Hex - 1 1/2" Thd.

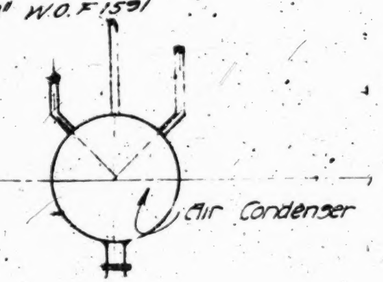


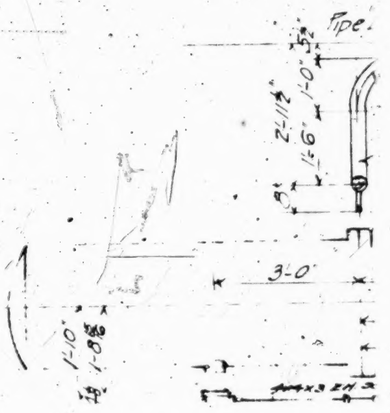
Plan



DETAIL OF PIPE 'A' W.O. F.1591
2- Required

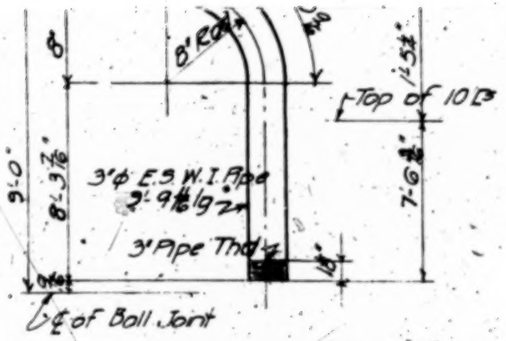


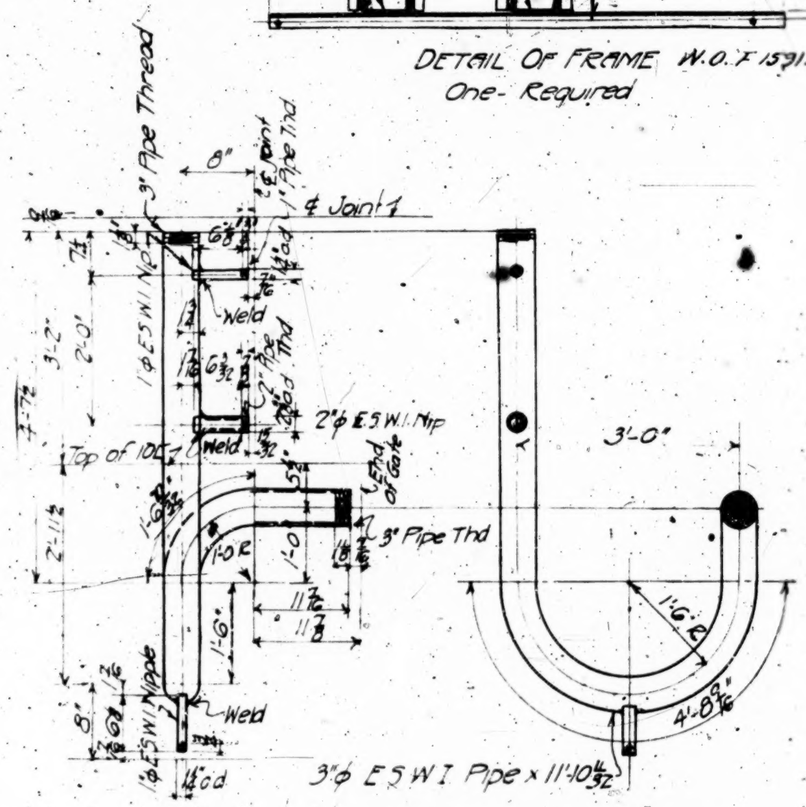


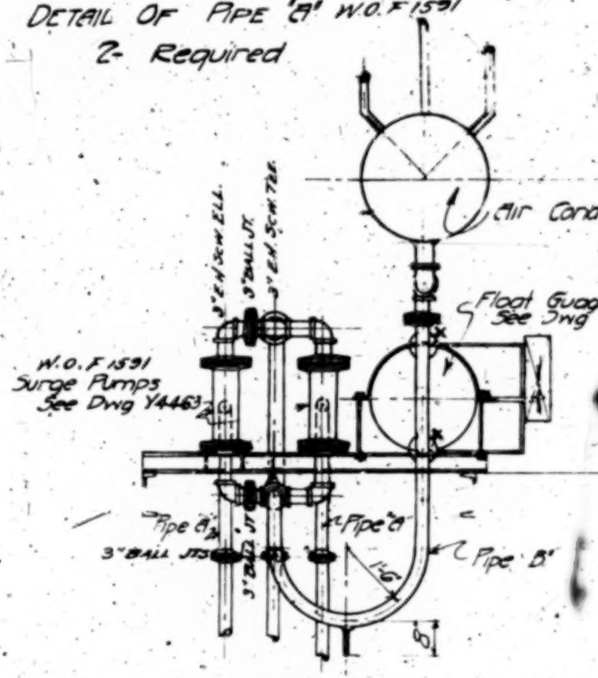


2831

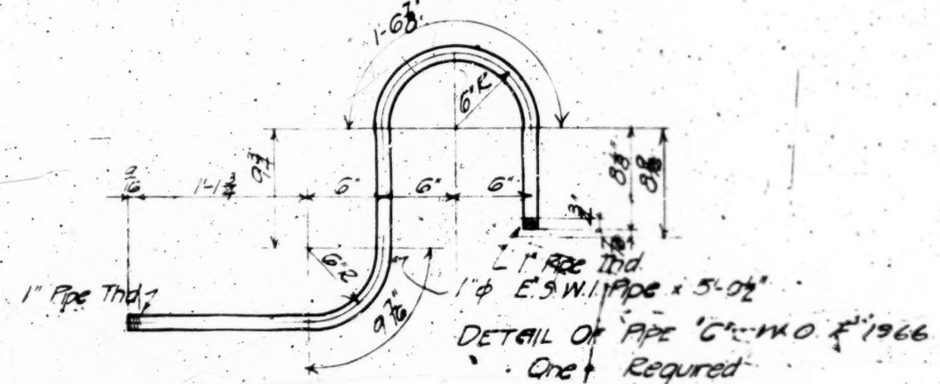
DETAIL OF FRAME W.O.F 1591.
One- Required

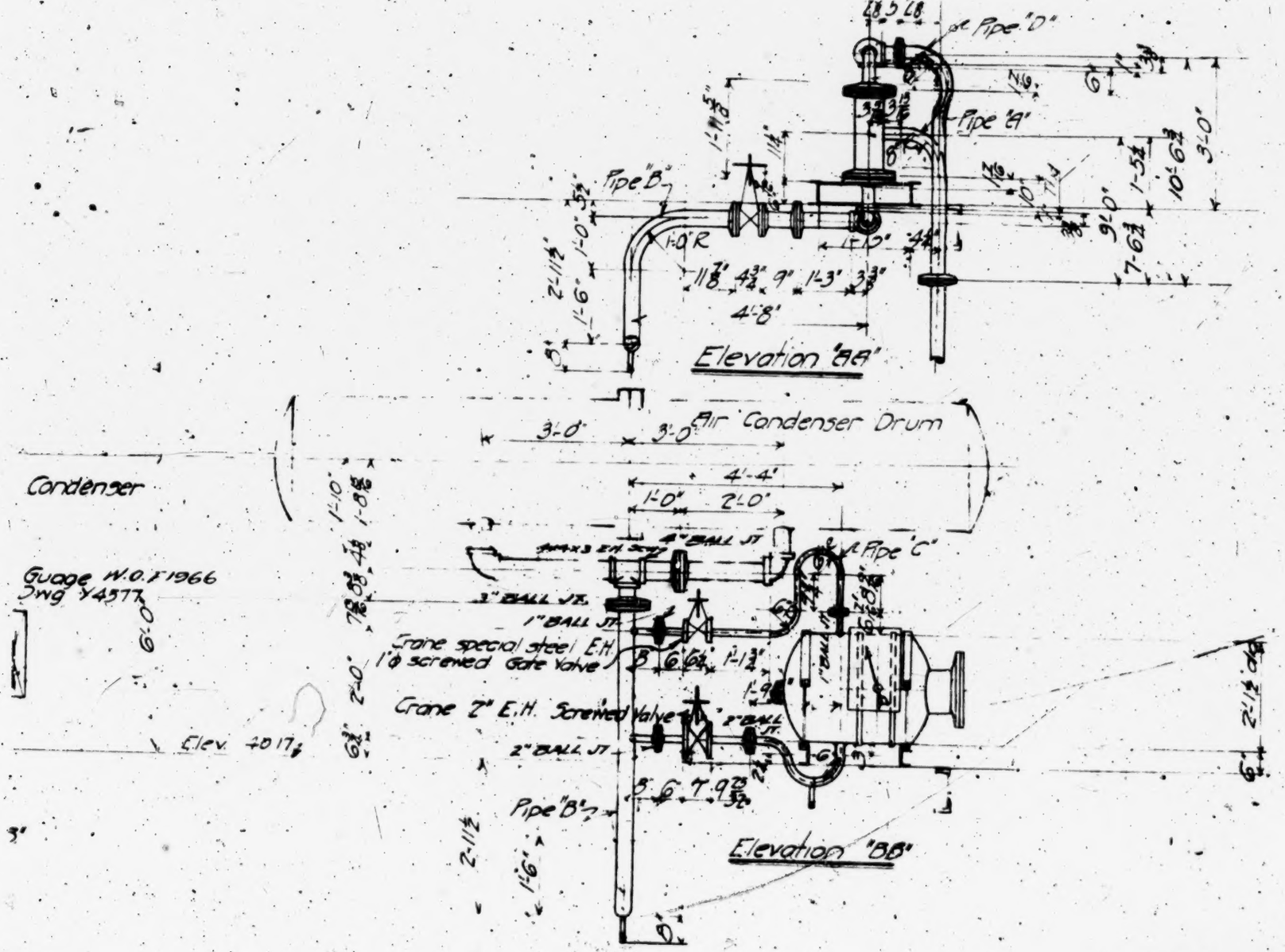

8" R
Top of 10"ϕ
3'ϕ E.S.W.I. Pipe
3'-9 19/32"
3" Pipe Thd
9'-0"
8'-3 7/8"
7'-6 1/4"
℄ of Ball Joint
DETAIL OF PIPE "A" W.O.F 1591
2- Required


3" Pipe Thread
8"
℄ Joint
1"ϕ E.S.W.I. Nipple
Weld
2"ϕ E.S.W.I. Nip
Top of 10"ϕ
3" Pipe Thd
1'-0" R
3'-0"
1'-6" R
4'-8 9/16"
3"ϕ E.S.W.I. Pipe x 11'-10 4/32"
DETAIL OF PIPE "B" W.O.F 1591
One Reqd


Air Condenser
Float Guage W.O.F 1966.
See Dwg Y4577
W.O.F 1591
Surge Pumps
See Dwg Y4463
Elev. 40'7"
Pipe "A"
Pipe "B"
Elevation "CC"

Plan
Pipe "A"
1'-0" R
3'-0"
3" BALL JT.
1" BALL JT.
Crane special steel E.H.
1ϕ screwed Gate Valve
Crane 2" E.H. Screwed Valve
2" BALL JT.
Pipe "B"


1-6 3/8"
6" R
6"
6"
6"
1" Pipe Thd
1"ϕ E.S.W.I. Pipe x 5'-0 1/2"
DETAIL OF PIPE "C" W.O.F 1966
One Required



DX 800

APPROVED	DATE
[illegible]	[illegible]

THE TEXAS COMPANY

REFINING DEPARTMENT
PORT ARTHUR WORKS

HOLMES-MANLEY VERTICAL STILL
FLOAT GUAGE & SURGE
JUMP FOR BELTTRAP LINES
BATTERY #4

DATE [illegible] REVISED:

SUPERSEDING [illegible] DRAWING NO. Y446 PRINT NO. 18590

4715 DX 802.

390

DEPARTMENT OF COMMERCE

United States Patent Office

To all persons to whom these presents shall come, Greeting:

This Is to Certify that the annexed is a true copy from the records of this office of the File Wrapper, Contents and all Drawings, in the matter of the

Letters Patent of

Pascal McDonald Biddison and Hugh T. Boyd,

Number 1,345,740, Granted July 6, 1920,

for

Improvement in Processes of Distilling Petroleum.

In Testimony Whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed, at the City of Washington, this sixteenth day of June, in the year of our Lord one thousand nine hundred and thirty-six and of the Independence of the United States of America the one hundred and sixtieth.

Conway P. Coe;
Commissioner of Patents.

(Seal)

Attest:
D. E. Wilson,
Chief of Division.

4717 (Stamp) $ Rec'd Feb 15 1918 C. C. U. S. Patent Office.

PETITION.

To the Commissioner of Patents:

Your Petitioners P. McDonald Biddison of Columbus, Franklin County, Ohio, and Hugh T. Boyd of Homer, Licking County, Ohio, and whose post office address is

52 West Gay St., Columbus, Ohio, pray that Letters Patent may be granted to them for the improvement in Process of Distilling Petroleum as set forth in the annexed Specification.

And they hereby appoint Spear, Middleton, Donaldson & Spear (Frank L. Middleton, Walter Donaldson, James M. Spear and William F. Hall), of Washington, D. C. (Registration Number 6323), Attorneys, with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein; to sign the drawings, to transact all business connected therewith, and to receive the patent.

Inventor's full name
P. McDonald Biddison
Hugh Thurman Boyd

(Stamp)

SPECIFICATION.

To All Whom It May Concern:

Be It Known That We, Pascal McDonald Biddison and Hugh T. Boyd, of Columbus and Homer, Ohio respectively, have invented certain new and useful Improvements in

Process of Distilling Petroleum

of which the following is a specification.

1

4718 Our invention has to do with an improvement in the distillation or treatment of petroleum particularly for obtaining therefrom low-boiling point hydrocarbons from higher boiling point hydrocarbons.

In the art of distilling residue of petroleum distillation such as gas oil or fuel oil at atmospheric pressure, vaporization begins at upwards of 450° F. and all will distill over at temperature upward of 650° F. In distilling this residue under a pressure upward of 3 atmospheres, a range of temperature of about 650°-850° F. is produced.

There are many objectionable features in the present
processes of distilling petroleum residues for the production
of low-boiling-point hydrocarbons; first, the danger of the
still bottom burning out under the excessive heat required
on the outside of the oil containing wall in order to attain
a "cracking" temperature on the oil within and the subsequent
discharge of a large volume of oil into the furnace, second,
the difficulty of maintaining a constant temperature due to
Per B carbon depositing on the ~~oil containing~~ walls *(OF THE STILL) and insulating
them, third, the difficulty of maintaining a constant pres-
sure on the system, fourth, the difficulty of maintaining
a constant rate of distillation, fifth, the difficulty of re-
moving carbon continuously from the system, sixth, the low
percentage of high boiling hydrocarbons converted to low boiling
point hydrocarbons.

The object of our process is to provide a method whereby these difficulties are reduced to a minimum in the
distillation of petroleum residue for the production of low-
boiling-point hydrocarbons. This is secured in our process by,
first, the fact that excessive heat is not required on the ~~oil~~
Per B ~~containing~~ walls *(OF THE STILL) which is attained by keeping the temperature

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4719 of the superheated gas high enough so that it, in connection

* Matter in parentheses inserted.

with the lower heat on the oil-container walls, causes most of the decomposition to the lower-boiling-point hydrocarbons; second, the maintenance of a steady temperature control by regulation of the flow of gas thru the superheater; third, the maintenance of very constant pressure by a regulating pressure valve on the gas inlet or outlet; fourth, the continuous removal of carbon by distillation from the cracked oil by means of intermediate stills so arranged that they can be used intermittently for removal of carbon and tar when it accumulates in quantity or can be used for the continuous removal of same, fifth, the maintenance of a steady rate of distillation by the gas flow.

By circulating oil at a fairly rapid rate, thru the retort thus increasing the rate of heat transfer from the walls of the oil containing vessel *(WE) ~~which~~ reduces the temperature required to be maintained on the walls of the oil containing vessel.

Per A

By agitation of the oil due to the rapid circulation and the injection of gas we prevent overheating of the molecules of the oil when they come in contact with the walls of the oil container.

It is admitted by numerous experimenters on oil-cracking processes that to produce gasol*(E)ine containing only a low percentage of unsaturated hydrocarbons of the olefine

* Matter in parentheses inserted.

series, that the low-boiling-point hydrocarbons must be re-
moved from the reaction zone as soon as formed. We reduce
the formation of unsaturated hydrocarbons of the olefine series
by the removal of the low-boiling-point hydrocar-
bons from the
liquid at the instant of formation by means of the injection
of large amounts of superheated gas, which pass-
ing thru the

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4720 oil immediately saturates itself with the low-boil-
ing hydro-
carbons, removes them from the liquid and thus largely prevents
the undue further cracking of these hydrocarbons to olefines.

We have found from our experimental work that the use
of a gaseous medium as used in our method, in-
volving the law of
partial pressures, is of great value in reducing the percentage
of un-saturated hydrocarbons of the olefin series. Without using
the gaseous medium, our resulting gasol*(E)ene contained almost
double the percentage of olefin hydrocarbons. We attribute the dif-
Per B ference in results to the low partial pressure *(OF) ~~on~~ the oil vapors
while in the process of decomposition at rela-
tively high tempera-
tures.

Insert A' (24)

In our experiments we have used natural gas containing
Per A about 80% methane and 15% eth*(A)ene by ordi-
nary combustion analysis
but we do not restrict ourselves to the use of this gas but

* Matter in parentheses inserted.

" A intend to cover other gases *(,) either natural gas of any composition,
" A coal gas *(,) water gas *(,) hydrogen *(,) nitrogen or any hydrocarbon gas or any other gas which will not produce combustion in the retort and which has the power of saturating itself with oil vapors,
Per B preferably a hydrocarbon gas in which *(SUBSTANCES BELONGING TO) the paraffin series predominate. For instance the gas generated in the cracking process can itself be compressed and re-circulated.
Per B *(IN THE) ~~The~~ accompanying drawing, Fig. 1, illustrates diagrammatically one form of apparatus comprising a so-called pressure still Figure*(.) 2, is a diagram showing the apparatus without intermediate
Per A tar stills. ~~Figure 3 shows a diagram of an apparatus omitting the means for carbon removal.~~

At 8 and 18 are shown tanks containing the oil being treated. From near the bottom of the tank 8 an outlet line 10 leads to either continuous still 11, or to tank 18 by valve 20 and line 19. From tank 18 the fresh oil is circulated by pump 22 thru line 23 to a preheating coil 6 where it is preheated before entering the "cracking" zone at 2. At a point outside of 2 superheated gas enters thru regulator valve 5 and coil 1. The gas-oil mixture passes out of cracking zone 2 into a small receiver 3 where any accumulated carbon can be
Per B blown out by *(WAY OF) valve 4. From 3 the gas-oil mixture passes

*Matter in parentheses inserted.

by line 7 back to storage tank 8. From tank 8 the gas

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4721 saturated with light and heavy hydrocarbons passes to a hot condenser 25 where by proper temperature regulation all heavy or "uncracked" oil can be returned from 26 and outlet line 27 back thru tank 18 to the circulating pump 22. From 26 the gas and light hydrocarbons pass by line 28 to cold condenser 29 where most of the light low-boiling-point hydrocarbons condense and pass by line 30 receiver 31. They can be drawn off here

Insert B' by line 33 and sent to gasol*(E)ine storage tanks by line 33 or sent back into circulation if not of high enough gravity *(B') in exceptional cases thru line 32. From receiver 31 the gas passes by 34 to any suitable scrubber or absorber 35 where the gas is scrubbed of any remaining gasol*(E)ine vapors by an

Per A absorbent menstru*(U)m entering at 38 and passing out at 39.

Insert B² *(B²) The denuded gas passes out of the system by valve 37 and line 36.

Fresh oil can be fed into the cracking system by line 40.

When, after considerable use, the system accumulates some tarry matter, valve 20 may be closed and valve 42 opened. Then the oil from 8 passes to still 11. From 11 the distillate vapors

" A pass by 15 to hot condens*(E)er 12 where any tarry matter carried

* Matter in parentheses inserted.

mechanically by the vapors is knocked out into 13 and which
tarry matter passes back to still 11 by line 14. The clean
" A. oil vapors pass thru heat exchanger 16 to a condens*(E)er 17 where
they are liqu*(E)ified and pass back into the system thru receiver
18 and circulating pump 22 by either valve 46 and line 23 or
valve 45 and line 43 and 44, in the latter case passing thru
heat exchanger 16.

Thus three systems of operation are available:

A system of operation where oil from tank 8 passes
directly to pump 22 thru line 10 valve 20 and pipe 19 thence
back thru line 23 to cracking zone, the oil in tank 8 gradually
diminishing in volume due to the products passing off at line
24, while still 11 is used intermittently for the removal of

5.

4722 — tarry matter and carbon by closing valve 20 and allowing oil
Per B to pass thru still 11 condenser 12, separat*(O)er 13, exchanger 16,
condenser 17, tank 18, pump 22, thence back to cracking zone
thru valve 45 line 43 exchanger 16 and pipe 44, valve 40 being
closed and no fresh oil being admitted during this system of
operation.

Or, the same system as above may be followed except
that the oil level in tank 8 is maintained at practically a
constant level by means of either continuous or intermittent

*Matter in parentheses inserted.

Insert A² admission of oil thru line 40. *(A²) (4)

Or a system of operation may be followed where the oil level in tank 8 is maintained at practically a constant level by means of either continuous or intermittent admission of oil thru line 40 and the still 11 is used continuously for

Per A the remov*(A)el of tarry matter and carbon by passing the oil from tank 8 thru valve 42 into still 11, thence thru condenser

" A 12, separat*(O)er 13, exchanger 16, condenser 17, tank 18 and pump 22 thence back to cracking zone thru pipe 43, exchanger 16 and pipe 44.

The following is a description of our process such as would enable any one skilled in the art to which it pertains, to use and apply the same.

Oil to be distilled is fed into the system thru line 40 and pump 22 until a sufficient charge is accumulated

Per B in tank 8. Then with valves 37, ~~32~~, ~~33~~, 41, 42, and 9 closed, *(AS WELL AS THE VALVES IN PIPE 32 AND 33,) the system is filled with gas thru regulator 5 and coil 1.

Heating of the furnace is started and oil is started in circulation by pump 22. The regulating valve 5 is set for the desired pressure and when the coil at 2 approaches the desired temperature and the superheated gas is considerably above the

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4723 desired cracking temperature, distillation is started by

* Matter in parentheses inserted.

partly opening the outlet valve 37 with absorbent oil circulating thru absorber 35, the gas plus hydrocarbons pass from tank 8 thru line 24 to hot condenser 25 where heavy hydrocarbons condense into receiver 26 and are let back into the system by valve 41 and line 27. The gas plus low-boiling hydrocarbons pass to a cold condenser 29 by means of line 28 where the most of the gasol*(E)ine condenses and falls into receiver 31. The gas, still containing some light hydrocarbons, passes by line 34 to absorber 35 where it is denuded of its gasol*(E)ine vapors by absorbent oil entering at 38 and passing out at 39, to a suitable distilling apparatus where the gasol*(E)ine is distilled off from the absorbent oil, the absorbent oil cooled and returned to scrubber by line 38. The denuded gas passes out of system by line 36.

Aftef the system has been in use for a considerable length of time, tarry matter accumulates to a slight extent, and this is removed as heretofore described.

Referring to figure*(.) 2, G is an oil storage tank with an outlet pipe line Z leading to force pump I which forces oil thru heat exchanger coil in H down into still D *(, WHICH SERVES AS A CRACKING COIL). At point C outside the pressure still D superheated gas enters from gas superheater A. The superheated gas plus oil mixture

* Matter in parentheses inserted.

after passing thru pressure still D comes out into small
receiver E where any accumulated carbon can be occasionally
blown out by the valve X. The gas oil mixture passes by line
F to reservoir G and the condensate passes around
Per B *(THE) system again.
The gas and uncondensed vapors pass to hot condenser K where
heavy hydrocarbons are condensed into receiver L and pass back
to reservoir G thru M. The gas saturated with light hydrocarbon
vapors, passes to condenser O, still under the pressure main-
tained in D and G, thru line N where the main low boiling

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4724 condensate is obtained in receiver P with outlet W. The gas
before passing back into the gas mains is passed thru line Q
to absorber R where the last valuable portions of gasol*(E)ine are
Per A removed by an absorbent menstru*(U)m entering at S and exiting
at T. The oil drawn off at T may be treated in any suitable
still to separate the absorbed gasol*(E)ine from the absorbent
" A menstru*(U)m. The denuded gas passes out thru valve V and line U.
By means of the auxiliary condenser K the heavier
hydrocarbons are knocked out of the gaseous mixture, into re-
ceiver L and the regulation of this condenser properly, permits
of drawing off gasol*(E)ine direct from the main condenser thru
tank P and line W, without redistillation.

* Matter in parentheses inserted.

~~*Referring to figure 3, the construction is the same as in figure 2, the only difference being in locating the reducing valve V between the receiver L and the condenser O,*~~

Per A ~~*instead of placing the valve in the gas exit pipe from the absorber.*~~

Per B When desired ~~*in all cases*~~ the gas from the outlet of the absorber can be returned by a suitable gas pump or compressor to the gas superheater in which case the gas regulator valve is preferably located on the outlet gas line of absorbers.

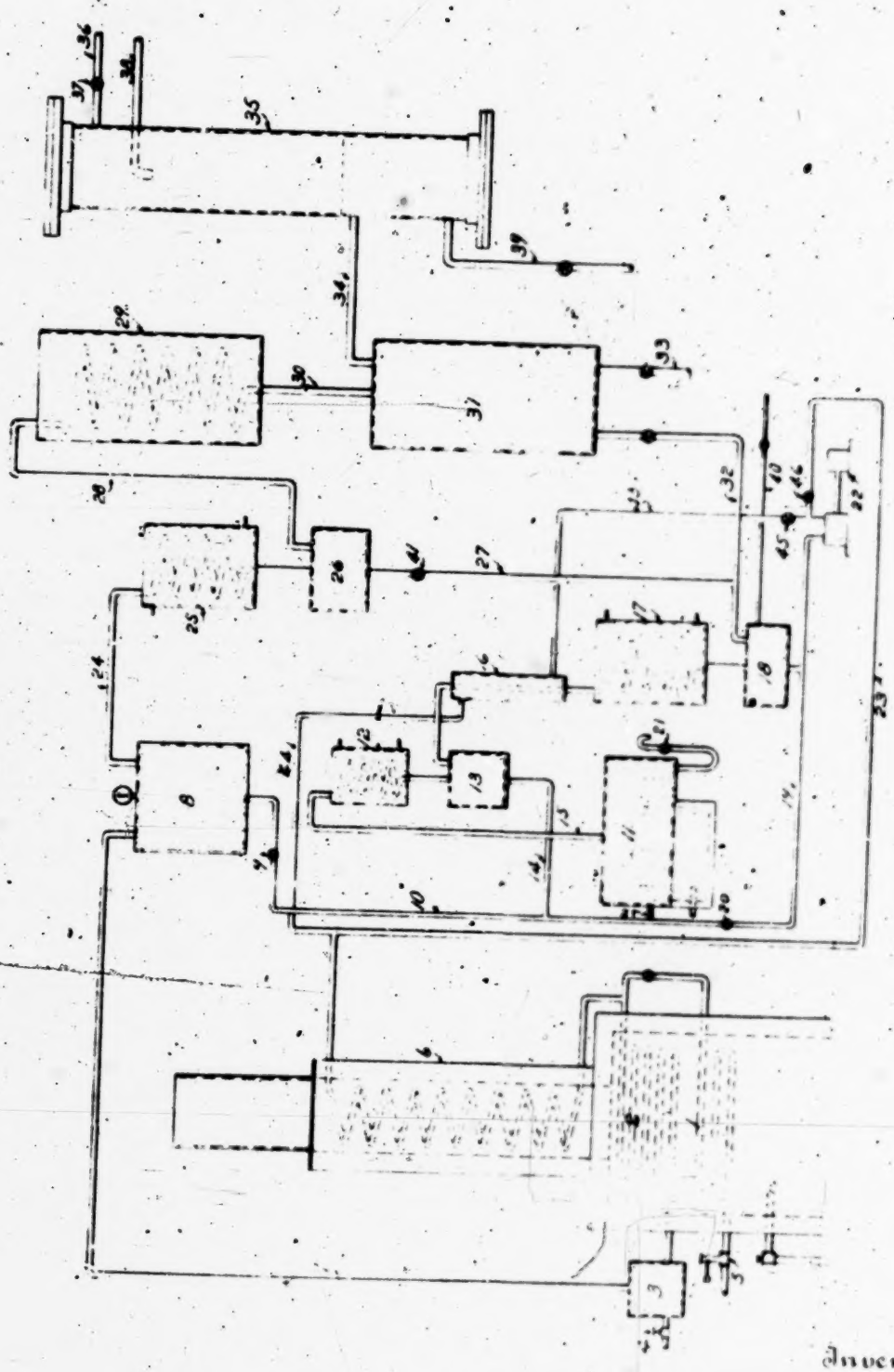

Fig. 1.

Inventors:

P. McDonald Biddison.
Hugh T. Boyd,

By Spear Middleton, Donaldson & Spear

Attorneys.

2847

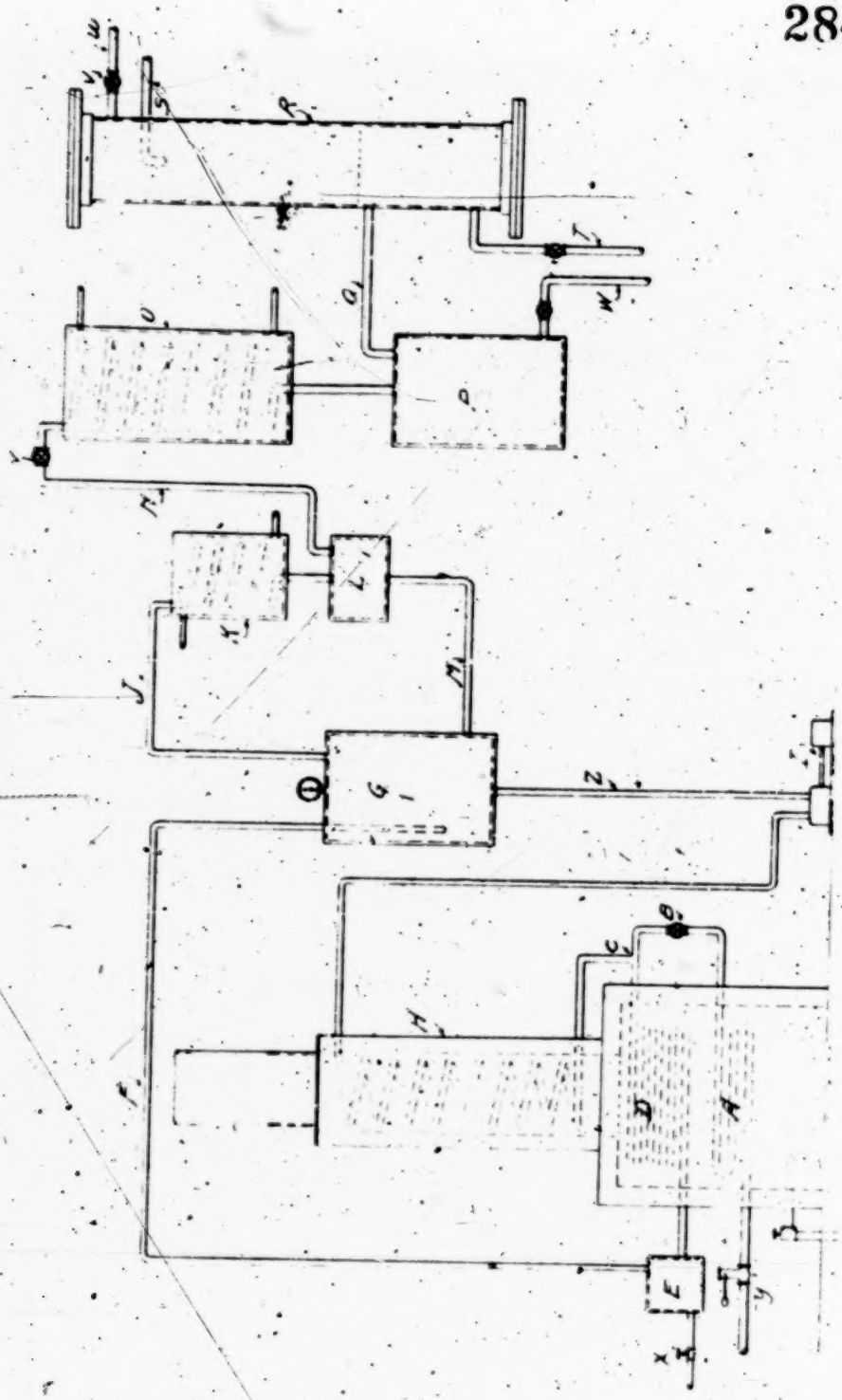

Fig. 2.

Inventors:
P. McDonald Biddison,
Hugh T. Boyd,
By
Spear, Middleton, Donaldson & Spear
Attorneys.

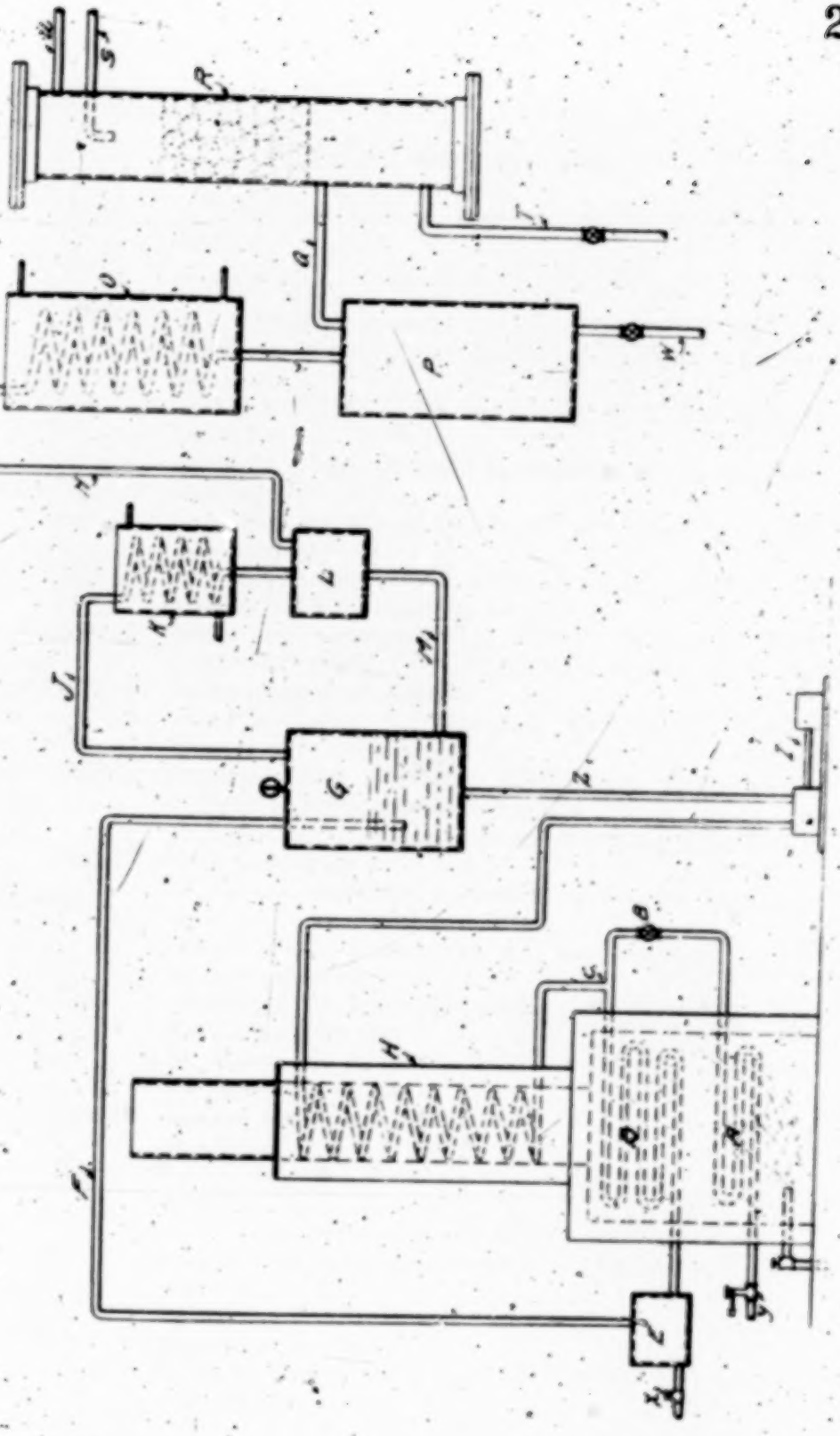

Fig. 3.

Inventors
P. McDonald Biddiscombe,
Hugh T. Boyd,
By Spear, Middleton, Donaldson & Shaw,
Attorneys.

4729 What we claim as new and desire to secure by Letters

Patent, is:

1. That process in the art of distilling liquid residues of petroleum distillation having a boiling point of upward of 400° F for the obtaining of low-boiling-point hydrocarbons, which consists in circulating the oil from and back to a bulk supply of the liquid maintaining on the oil a pressure which prevents fractional distillation, *(NOT LESS THAN) ~~equal to or greater than~~ the pressure *(UNDER WHICH THE VAPORS ARE CONDENSED) ~~of the oil in the latter stages of distillation,~~ by means of injected *(HIGHLY) ~~super~~heated gas; continuing the cracking and starting distillation by causing *(HIGHLY) ~~super~~heated gas to flow thru ~~cracking zone, bringing back to the bulk supply~~ ~~of the oil any liquid condensed by the auxiliary condenser, or condensers,~~ cooling the gas and vapors in the main condenser; absorbing the last traces of gasol*(E)ine from the gas in an absorber by means of an absorption menstru*(U)m ~~while removing from the system tarry matter etc., from the bulk supply of the liquid by *(DISTILLATION) means for a still or stills,~~ as described.

Per B

Per A

Per A

Per C

Sub B3

Per B

Per A

2. That process in the art of distilling liquid residues of petroleum distillation having a boiling point of upward of 400° F for the obtaining of low-boiling-point hydrocarbons, which consists in circulating the oil from and back to

* Matter in parentheses inserted.

a bulk supply of the liquid; maintaining on the oil a pressure
which prevents fractional distillation, equal to or greater
" A than the pressure *(UNDER WHICH THE VAPORS ARE CONDENSED) ~~of the oil in the latter stages of distillation~~, by means of injected *(HIGHLY) ~~super~~-
Per B heated gas; continuing
" " the cracking and starting distillation by causing *(HIGHLY) ~~super~~heated gas to flow
Insert thru cracking zone; *(B^4) bringing back to the
B^4 bulk supply of the oil

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4730 any liquid condensed by the auxiliary condenser
Per B ~~or con-~~
~~densers~~, cooling the gas and vapors in the main condenser under
" " a pressure *(ABOUT) equal to the pressure on the oil during distillation;
absorbing the last traces of gasol*(E)ine from the gas in an
absorber by means of an absorption menstru*(U)m; removing from the
Per C system tarry matter *etc.*, from the bulk supply of the liquid
Per A by *(DISTILLATION) ~~means of a still or stills~~ while maintaining a constant
amount of oil in the system by addition of new oil.

3. That process in the art of distilling petroleum
residues having a boiling point of upwards of 400° F. for the
production of lower boiling point hydrocarbons, which consists
in circulating the oil from and back to a bulk supply of the
liquid while maintaining on the oil a pressure which pre-
Per B vents fractional distillation *(NOT SUBSTANTIALLY LESS) ~~equal to or greater~~ than the
Per A pressure *(UNDER WHICH THE VAPORS

*Matter in parentheses inserted.

ARE CONDENSED) ~~of the oil in the latter stages of distillation,~~

Per B by means of *(HIGHLY) ~~super~~heated gas; continuing the cracking and

" " distillation by causing *(HIGHLY) ~~super~~heated gas to flow through the

Insert B⁴ cracking zone; *(B⁴) bringing back to the bulk supply of the oil

any liquid condensed by the auxiliary condenser, cooling the

gas and vapor in the main condenser and absorbing the last

traces of gasol*(E)ine in any suitable absorber by *(THE WAY OF) means of a suitable

absorption of menstru*(U)m.

Insert B⁵

4731 In Testimony Whereof we affix our signatures. 10

P. McDonald Biddison,
Hugh T. Boyd.

Oath.

State of Ohio
County of Franklin } ss.

P. McDonald Biddison and Hugh T. Boyd the above-named petitioners, being sworn (or affirmed) depose and say that they are citizens of the United States and residents of Columbus and Homer, Ohio, respectively that they verily believe themselves to be the original, first, and joint inventors of the improvement in Process of Distilling Petroleum described and claimed in the annexed specifications; that they do not know and do not believe that the same was ever known or used before their invention or discovery thereof, or patented or described in any printed publication in any country before their invention or discovery thereof, or more than two years prior to this application, or patented in any country foreign to the United States, on an application filed more than twelve months before this application, or in public use or on sale in the United States for more than two years prior to this appli-

* Matter in parentheses inserted.

cation; and that no application for patent on said improvement has been filed by them or their representatives or assigns in any country foreign to the United States;

Inventor's Full Name { P. McDonald Biddison
Hugh T. Boyd.

Sworn to and subscribed before me this 28th day of Jan., 1918.

H. J. Long,
(Signature of Justice or Notary)
Notary Public.
(Official Character)

(Seal)

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4732 Div. 31 Room 172.

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name.

Paper No. 2.

All communications respecting this application should give the serial number, date of filing, title of invention, and name of the applicant.

DEPARTMENT OF THE INTERIOR

United States Patent Office

Washington

(Stamp) U. S. Patent Office Mar 21 1918 Mailed.

Mar. 21, 1918.

Spear, Middleton, Donaldson & Spear,
Victor Bldg.,
Washington, D. C.

Please find below a communication from the Examiner in charge of the application of Biddison & Boyd, No. 217,440, filed Feb. 15, 1918, Process of Distilling Petroleum.

James T. Newton,
Commissioner of Patents.

Page 2, line 14-18 are grammatically incorrect in that there is no principal verb to complete the sentence. Page 3, lines 10-12, what causes the low partial pressure of the oil vapors? Line 14, correct spelling of ethane. Line 16, after "gases" and line 17 after "hydrogen" insert a

comma. Lines 25-27, cancel Fig. 3, as it adds nothing material to the disclosure. The valve V of Fig. 3 may be placed on Fig. 2. Page 5, lines 7-14 and 23-24, how can tank 8 be filled by means of pump 22? Line 15, correct spelling of removal. Throughout the specification correct the spelling of separator, condenser and menstruum.

Claims 1, 2 and 3, lines 7, cancel "of the oil in the latter stages of distillation" and insert under which the vapors are condensed. Claim 1, line 16 and claim 2, line 17, cancel "means of a still or stills" and insert distillation.

Claim 3 is rejected on the following patents:

Bacon et al, 1,131,309, Mar. 9, 1915, 196-31, Leffer, British, 19,051, Aug. 20, 1912, 196-27.

Claims 1 and 2 may be allowed if properly amended.

The following patent is recorded:

Curran, 1,255,714, Feb. 5, 1918, 196-13,

Leffer shows the injection into the oil of preheated gas.

C. S. Grinelle,
Examiner.

H.C.B.

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4734 U. S. Patent Office, Serial No. 217,440

Received
Aug 12 1918 A
Division 31, Paper No. 3

(Stamp) Application Div. Aug 10 1918 U. S. Patent Office. Room 172.

P. McD. Biddison, et al.,

Process of Distilling Petroleum.

Filed February 15th, 1918.
Serial Number 217,440.

Hon. Commissioner of Patents:

Responsive to the official letter of Mar. 21, 1918;

Page 2, line 16 change "which" to — we — Same line change "reduces" to — reduce —

Page 3, between lines 12 and 13 insert

In our process only a portion of the oil in the cracking zone is in the vapor state. These vapors from

A[1] the oil are mixed with the superheated gas that has been ad-
Per B mitted into the cracking zone. The pressure *(OF) ~~existing on~~ these
oil vapors then depends upon the proportion they form of the
total vapors present according to the physical law of partial
pressures of mixed gases and vapors. If the pressure in the crack-
ing zone is 100 pounds absolute, and the oil vapors constitute
one per cent. of the total vapors present, than the pressure *(OF) ~~on~~
the oil vapors is one per cent of 100 pounds or one ~~pound, and~~
the pressure of any one constituent of the oil vapors depends
in like manner upon its proportion of the whole amount of
vapors present. Our experiments and study have convinced us
that while heat is necessary to break up the heavy oil into
compounds of lower specific gravity, that pressure on the cracking
vapors aids the formation of unsaturated com-
pounds and retards
the breaking up of the heavy hydrocarbons. In the system which we

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4735 outline, in this application we can get the tempera-
ture
required for breaking up the heavy compounds while still
Per B maintaining a low pressure *(OF) ~~on~~ the oil vapors. This actually
results in an increased yield of gasol*(E)ine con-
taining a very
low per cent. of unsaturated hydrocarbons. At the same time

* Matter in parentheses inserted.

this injected gas serves the very valuable purpose of removing from the liquid the gasol*(E)ine as quickly as formed.

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4736 With regard to the British patent Leffer applicants believe that this process is essentially different from theirs in that Leffler does not maintain on his liquid

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4737 a temperature sufficient to crack the constituents of this liquid, but as a matter of fact avoids this pressure and converts the liquid into a vapor, which vapor is heated in a second retort. Thus, his process is essentially a vapor phase cracking, whereas applicant's process is essentially a liquid phase cracking. That is, applicants maintain on the liquid such a pressure as will prevent the vaporization of any portion of the liquid, except such portions as are decomposed by the temperature maintained, so that the vapors in applicant's system are vapors of hydrocarbons lighter than the charge of oil, mixed with the injected gas, whereas Lefflers vapors are vapors of the oil, which vapors are subsequently with an added gas heated to the cracking temperature. The other essential difference is that in the reference the gas is injected, not into the body of the liquid but into the vapors distilled from the liquid, and another essential difference is that the vapors which are injected are not superheated, previously, to a temperature equal to or greater than the temperature maintained on the oil, but receive the entire heat content, while they are intermingled with the oil vapors.

Respectfully,
By Spear Middleton Donaldson & Spear
Attys.

August 10th, 1918.
JMS/BIB

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4742 IN THE UNITED STATES PATENT OFFICE.

(Stamps) Application Room Nov 4 1919 U. S. Patent Office. Paper No. 5 Nov 5 19 (illegible) Division 31.

In re application of
Biddison & Boyd,

Distilling Petroleum,

Serial No. 217,440.
Filed February 15, 1918, Div. 31.

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

Responsive to Office letter of November 30, 1918, amend the above application as follows:

Page 1, line 19, change "oil x x walls" to —walls of the still—

Page 1, lines 30 and 31, same change.

Page 3, line 10, change "on" to —of—

Page 3, line 20, after "which" insert —substances belonging to—

Line 25, change "The" to —In the—

B¹ Page 4, line 9, after "gravity" insert —(Bé) or in other words, of too high boiling point,—

B² Page 4, line 13, after "39", insert —Heavy oil may be used as the absorbent in 35.—

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4744 The applicants do not limit the invention to the use of only the valves shown in the drawing. Obviously, others can be used. No two plants are exactly alike, but the arrangement of the valves, obviously, is to fit the particular plant. The same remarks are true as to the relative elevations. Liquids will flow down-hill by gravity, or will flow up-hill if aided by a suitable pump. The valves and elevations shown in the drawing are suitable for the purpose, but the invention is not restricted thereto.

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4745 The legends and arrows on the drawing will be supplied, as also the pipe connection from 36 to 5.

Regarding the examiner's question about filling, note page 5, line 24 "a sufficient charge" which does not necessitate "quite full".

It is requested that the requirements for the further detailed information be waived. A patent specification is addressed, not to savages who never heard of refining and cracking oil, but to intelligent persons skilled in the art. If the examiner were managing director of an oil-producing and cracking company, and had a works manager who could not operate the invention from the data given in the specification, he would probably not wait until Saturday night, to fire him.

In regard to blowing out the carbon through the valve 4, it would seem entirely unnecessary to tell any intelligent person, that this valve should be opened. If the examiner desires such statements as this to be made in full, throughout the case, a new specification of 50 to 75 pages will be necessary.

25

4746 Line 14, page 1, Examiner's letter Nov. 30.

Line 10, page 3 of application refers to the "low partial pressures on the oil vapors", this low partial pressure on the oil vapors being due to the fact that into the cracking zone 2 of Figure 1 is injected heated gas so that of the total pressure on cracking zone (say 100 pounds) only a small portion is exerted by the oil vapors, the amount of this partial pressure being dependent upon the relative proportions of oil vapors to injected heated gas so that if the oil vapors constitute 1% of the total vapors present then 1% of the total pressure of 100 pounds or 1 pound would be the pressure on the oil vapors. See attorney's letter of August 10th responsive to official letter of March 21, first paragraph.

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4747 Page 2 Examiner's letter November 30. Paragraph 1.

The amendment submitted for insertion between lines 12 and 13 was submitted as an explanation of the results obtained, that the reasons for the method might be made clearer. The Examiner appears to have misinterpreted this amendment, for he refers to our claiming that by the use of gas we work at lower temperatures than would otherwise be required. This amendment makes no such

claim. What this amendment states is that by the use of injected hot gas, we are able to heat the liquid to the temperature required for cracking without maintaining an excessive pressure on the vapors from the oil, and it states it in these words: "In the system which we outline in this application we can get the temperature required for breaking up the heavy compounds while still maintaining a low pressure on the oil vapors," and the paragraph explains that this low pressure on the oil vapors is due to the fact that there being gas mixed with the oil and oil vapors, the pressure of the oil vapors is less than the pressure that would be measured by a gauge, according to the law of partial pressures. The amendment in this respect is on an amplification of lines 4 to 12 of page 3, and is not new matter in any sense. However, at the bottom of page 1 we do indicate that we can operate with a low temperature on the "oil containing walls" of the cracking zone. Further reference to this is made at line 14 to 22 on page 2.

27

4748 The examiner, in this same paragraph, states further that we have not previously indicated that "* * * then oils are partially, but not completely, vaporized * * *". To correct this statement, I quote beginning at line 37 page 3 "From 3 the gas-oil mixture passes by line 7 to storage tank 8". That is, the contents of line 7 is a mixture of oil and gases passing from cracking zone 2 to the tank 8, in which the gases separate from the oil. Also see page 6, lines 23 to 27, covering this same point and refer to the claims "circulating the oil from and back to a bulk supply of the liquid." See also claim 1, line 9, "starting" distillation. This does not mean completely distilling.

Line 21, page 2, Examiner's letter Nov. 30.

Carbon or coke formed in the cracking coils 2 or D will largely pass out into 3 or E, though some may adhere to the walls of the coils. If 3 or E be made of such size as to give a low velocity to the oil in 3 or E, the carbon or coke will settle out of the oil in 3 or E by opening the valve 4 or X. This is not an essential step in the system, but is desirable. The coke and carbon can also be removed at a latter stage of the cycle in still 11 of Figure 1 along with the tarry matter.

4750 28

Respectfully,
Spear, Middleton, Donaldson & Spear,
Attys.

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4758 Div. 31—AMT

Address Only
The Commissioner of Patents,
Washington, D. C.

Serial No. 217,440

2—181

DEPARTMENT OF THE INTERIOR

United States Patent Office

Washington

(Stamp) Patent Office May 11 1920 Mail Div.

May 11, 1920.

P. McDonald Biddeson and Hugh T. Boyd.

Sir: Your Application fo a patent for an Improvement in Process of Distilling Petroleum filed Feb. 15, 1918, has been examined and Allowed.

The final fee, Twenty Dollars, must be paid not later than Six Months from the date of this present notice of allowance. If the final fee be not paid within that period, the patent on this application will be withheld, unless renewed with an additional fee of $15, under the provisions of Section 4897, Revised Statutes.

The office delivers patents upon the day of their date, and on which their term begins to run. The printing, photolithographing, and engrossing of the several patent parts, preparatory to final signing and sealing, will require about four weeks, and such work will not be undertaken until after payment of the necessary fee.

When you send the final fee you will also send, Distinctly And Plainly Written, the name of the Inventor, Title Of Invention, And Serial Number, As Above Given, Date Of Allowance (which is the date of this circular), Date Of Filing, and, if assigned, the Names Of The Assignees.

If you desire to have the patent issue to Assignees, an assignment containing a Request to that effect, together with the Fee for recording the same, must be filed in this office on or before the date of payment of final fee.

After issue of the patent uncertified copies of the draw-

ings and specifications may be purchased at the price of Ten Cents Each. The money should accompany the order. Postage stamps will not be received.

Final fees will Not be received from other than the applicant, his assignee or attorney, or a party in interest as shown by the records of the Patent Office.

Respectfully,

James T. Newton,
Commissioner of Patents.

Spear, Middleton, Donaldson & Spear
Victor Bldg.
Washington, D. C.

(In left-hand margin) ☞ In Remitting The Final Fee Give the Serial Number At The Head Of This Notice.

(In right-hand margin) ☞ Uncertified Checks Will Not Be Accepted.

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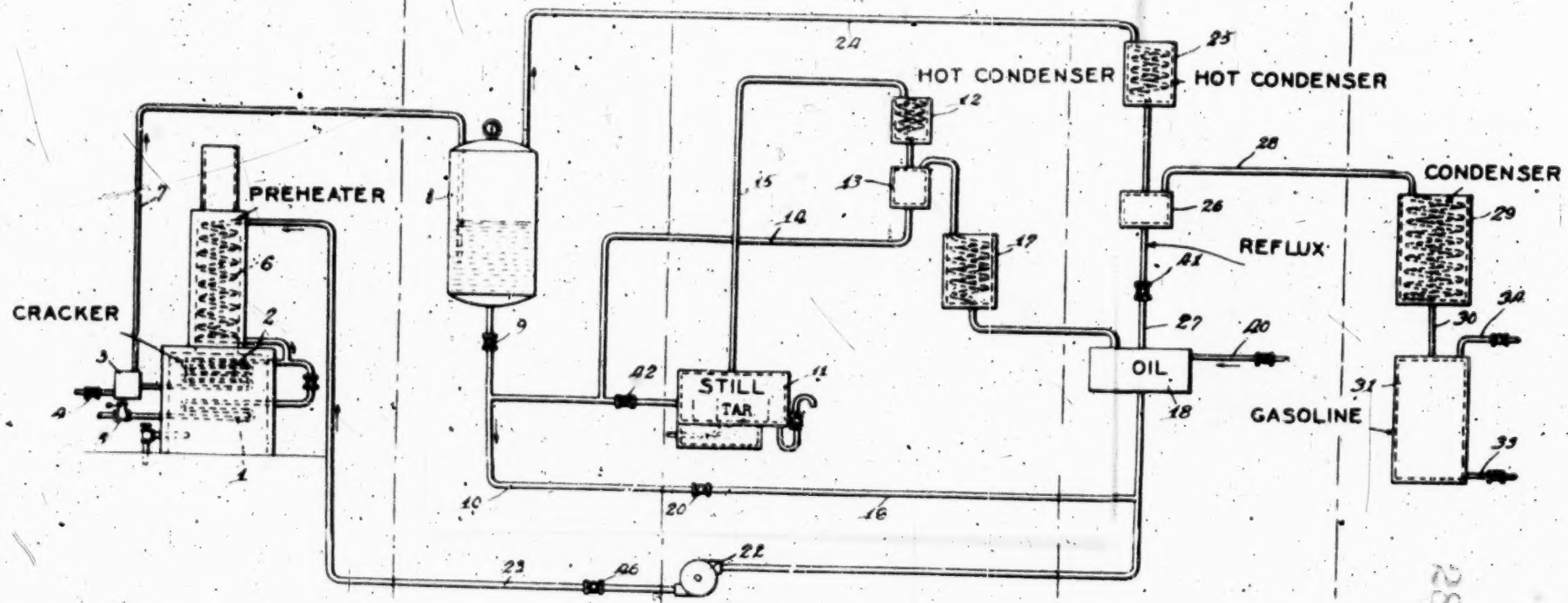
BIDDISON & BOYD PAT. NO. 1,345,740
FILED FEB. 15, 1918 ISSUED JULY 6, 1920

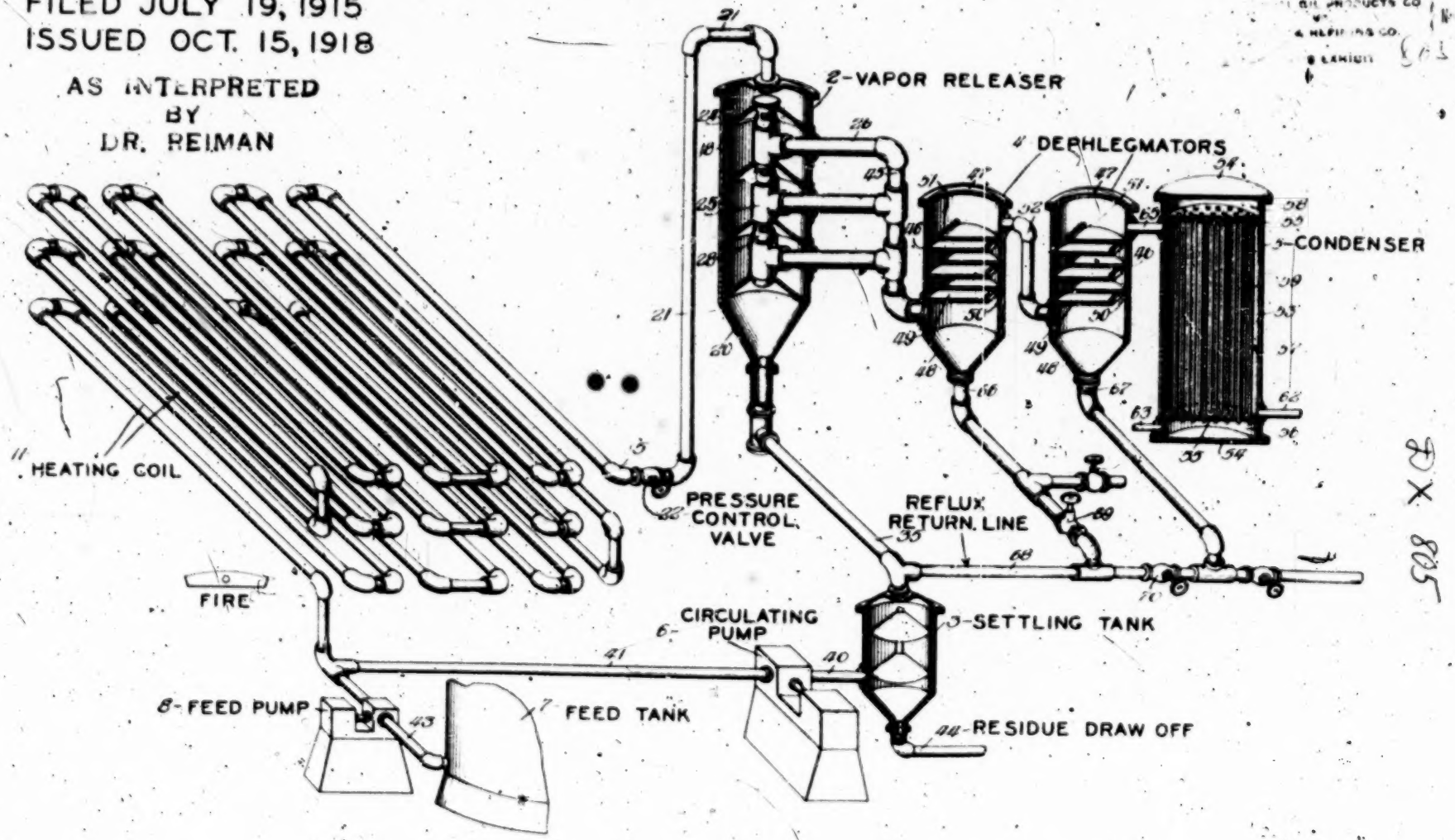
DX 803

AS INTERPRETED
BY
DR. REIMAN



TRUMBLE PAT. NO. 1,281,884
FILED JULY 19, 1915
ISSUED OCT. 15, 1918

AS INTERPRETED
BY
DR. REIMAN



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DEPARTMENT OF COMMERCE

United States Patent Office

To all persons to whom these presents shall come, Greeting:

This Is To Certify that the annexed is a true copy from the records of the office of the File Wrapper, Contents and Drawings, in the matter of the

Letters Patent of

Clive M. Alexander, Assignor to

Gulf Refining Company,

Number 1,407,619, Granted February 21, 1922,

for

Improvement in Manufacture of Motor Fuel.

In Testimony Whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed, at the City of Washington, this fifth day of November, in the year of our Lord one thousand nine hundred and thirty, and of the Independence of the United States of America the one hundred and fifty-fifth.

Thomas E. Robertson,
Commissioner of Patents.

(Seal)

Attest:

D. E. Wilson,
Chief of Division.

Endorsed: Filed Aug. 9, 1940. Hoyt King, Clerk.

4774 (Stamp) $15 Rec'd Nov 30 1917 C. C. U. S. Pat. Office.

PETITION.

To the Commissioner of Patents:

Your petitioner Clive M. Alexander, a citizen of the United States and a resident of Port Arthur in the County of Jefferson and State of Texas whose post-office address

is c/o Gulf Refining Company, Port Arthur, Texas prays that Letters Patent of the United States may be granted unto him for the improvements in Manufacture of Motor Fuels as set forth in the annexed specification.

And he hereby appoints K. P. McElroy (registry No. 7294), of 711 G Street, Washington, D. C., his attorney, with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to sign drawings, to receive, or to refuse to receive, the Letters Patent when granted, and to transact all business in the Patent Office connected therewith.

Signed at Port Arthur in the County of Jefferson and State of Texas this 23 day of November 1917.

Clive M. Alexander.

SPECIFICATION.

To all whom it may concern:

Be it known that I, Clive M. Alexander, a citizen of the United States, residing at Port Arthur, in the County of Jefferson and State of Texas, have invented certain new and useful improvements in Manufacture of Motor Fuels, of which the following is a specification:

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4775 This invention relates to the Manufacture of Motor Fuels; and it comprises a method of making motor fuels of the nature of gasoline and containing large proportions of readily volatile, readily ignitable hydrocarbons from petroleum materials of higher initial boiling point, (such as crude petroleums and petroleum residue and distillates such as gas oil, solar oil, kerosene), by cracking such higher boiling oils with the aid of heat wherein the higher boiling oils are vaporized (with or without cracking according to the nature of the oil) and the vapors are passed through a tubular crack-

ing zone, the temperature of such zone, its length and the
volume of vapors passed through such zone being so correlated
that only a partial cracking occurs therein and much of the
vapors so passed emerges uncracked, the general rule being
to carry the cracking only so far that at least 40 or 70 per
cent of oil of as high boiling point as the initial oil can
be, and is, recovered;—the high boiling oil so recovered being,
if desired, returned to the still or other source of vapors;
and it more particularly comprises a method of making motor
fuels in the distillation of petroleum materials, such as crude
oil, wherein such materials are distilled down in stages in a
still provided with the usual air cooled tower or dephlegmator
(which may be arranged to drain back to the still) and with
the usual positively cooled condensers beyond, the vapors in
one stage of the operation being sent directly to said plurality
of condensers and at another stage being sent thither through a
cracking tube or retort; all as more fully hereinafter set
forth and as claimed.

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4776 In view of the extended use of gasoline engines many efforts have been made to develop new sources of motor
fuel adapted for use in internal combustion engines. Many
mixtures of various combustible liquids have been proposed as

gasoline substitutes and many methods have been suggested, and
to some extent are in use, for increasing the yield of "gasoline"
from petroleum. Most of the substitutes and most of the pro-
ducts of these methods, are not wholly composed of easily
volatile oils or substances. With the usual types of carbureters,
it is only necessary that some portion of the composition be
readily volatile to facilitate quick ignition. The lighter
the specific gravity of a petroleum oil, the lower is its boil
ing point and the greater its volatility; and, vice versa,
the heavier an oil, the higher is its boiling point and the
less its volatility. For this reason it is customary to buy and sell gasoline on the specific gravity (Baumé degrees)
since the lighter an oil is the greater is its volatility and
the better it is adapted as a motor fuel. The Baumé degree
alone however is not a sufficient index to the nature of an
oil since obviously a mixture of rather heavy oils and rather
Ptr A light oils may have an averaged specific gravity the same as
that of a distillate mainly composed of oils of medium specific
gravity. For this reason, as a further characterization there
is sometimes used the "end dry point"—the temperature at which
the final residues of a given sample will all boil away. This
indicates the character of the heavier constituents of a given
gasoline or motor fuel.

4777 All natural petroleums are mixtures of relatively heavier and relatively lighter oils; and most varieties of crude oil will give upon distillation some proportion of light oils which upon condensation can be sold as gasoline. The character of this gasoline as regards specific gravity and end dry point of course depends upon the crude oil and the circumstances of distillation; upon the amount of less volatile oils going over and collected with the more volatile oils. This natural gasoline is known as refinery gasoline.

It is a very old proposition to obtain in addition to this refinery or natural gasoline a further proportion of "cracked gasoline" produced by breaking down the heavy hydrocarbons by heat; and many ways of effecting this breaking down have been proposed. A number of these are in practical use. Any heavy oil will break down into lighter products when heated to a sufficient temperature for a sufficient time; whether the heating be of the liquid oil or of its vapors. The degree to which it breaks down depends altogether on circumstances; breaking down may go so far as to give permanent gases (oil gas) as the main product or it may go only so far as to produce gasoline, or even kerosene. Most of these prior methods have failed in producing the best results, i. e., the production of a maximum amount of oils sufficiently light and

volatile to be salable as gasoline. This was for the reason
that the treatment was too far-going and too drastic; the
effort was to produce the maximum possible amount of cracking
in a given treatment. To this end, liquid oil has been superheated under pressure sufficient to keep it liquid; oil has

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4778 been sprayed into very hot chambers under very high pressure;
oil and oil vapors have been run over red hot catalysts, etc.
These processes all produce gasoline; but they do not give
high yields; there is too much decomposition of oil into gas
and coke and tar.

I have found that better results can be obtained by a more moderate treatment; that it is much better not to
try to do too much cracking in an operation but to leave a
substantial proportion or even a major fraction of the oil
unacted on. In so doing this oil acts as a shielding agent
as regards the cracked products, preventing the conversion
going too far. And in order that I may obtain a uniform
heating and uniform action I find it is better to do the heating with the oil in a vaporized condition. The vapor I use
as dry as possible, that is as free as possible of droplets or
suspended portions of liquid oil. This is for the reason that
the heat of vaporization of oil is quite high and in the pre-

sence of liquid oil in the cracking zone heating conditions
are apt to become irregular because of the absorption of heat
in vaporization; I cannot get the uniform temperature conditions throughout the mass of vapor that I strive to attain.
For this reason I find it best to work with a "dry" vapor.
Since as I find the matter of cracking is simply that of
getting the hydrocarbon up to the right temperature and as
pressure and other complications are of little or no use,
I operate at about atmospheric pressure; using no more pressure
in any event than is necessary to produce movement of my vapors.

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4779 It is even better not to use this much pressure, or indeed
to use a slight degree of vacuum since the vapors can be moved
by suction as readily as by pressure and a slight degree of
vacuum promotes the volatilization of any liquid oil that
may be present. A little steam, up to a per cent or so,
has about the same effect as the use of a slight vacuum.
The use of any greater proportion of steam is not worth while
and is disadvantageous because it lessens the capacity of
the apparatus. It seems to have no particular influence on
the cracking operation, otherwise, one way or the other. The
use of catalysts is unnecessary.

By producing only a limited cracking of oil vapors

at about the ordinary pressure, the operation becomes so positive that changes in conditions do not much affect the result. There is therefore no use for the complications and refinements of the prior cracking methods. As a cracking zone I ordinarily use an iron or steel tube of, say, 6 or 8 inches internal diameter which may be vertical with upward or downward flow of vapors or may be horizontal or inclined. The interior of this tube is open and unobstructed. Any ordinary heating means may be employed such as gas firing, coke firing, etc. One or more tubes may be used in a single heating chamber. No rigid control of temperature in the heating means is necessary since whatever the temperature of the iron or steel tube, as long as it is high enough, the temperature within will be governed by the amount or volume of vapors sent through. In order to produce any given average tempera-

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4780 ture of the vapors passing through the tube, the volume so transmitted may be varied. The temperature of the iron tube or the furnace chamber surrounding it may range between 450 and 700° C. (842-1292° F.) without affecting the operation. The higher the temperature the more vapor must be sent through per minute and vice versa. A temperature of 500° C. (932° F.) in the furnace chamber works well.

The conditions of operation are governed more by observation of the character of the vapors passing beyond the cracking zone than by any control of the temperature of the furnace chamber. The object is, in all cases, to effect only a partial cracking of the vapors in a single passage. Ordinarily I control conditions so that on cooling the vapors a condensate will be obtained of which at least 40 to 70 per cent (calculated on the oil used to furnish the vapors) is as high boiling as the oil used to furnish the vapors. In other words, ordinarily I only about half crack, so to speak.

The vapors supplied to the cracking zone may be those of any oil higher boiling and heavier than gasoline. Naturally, the lower boiling the oil used the easier it is to convert it into gasoline with a large yield; kerosene, for example, being easier to crack down into gasoline than is gas oil or solar oil. Kerosene can be vaporized without much cracking in the vaporization and the same is true of many gas oils and solar oils. Other oils of heavier nature generally crack down to some extent in being converted into vapors and the vapors are therefore of oils lighter than those which are distilled. Therefore in speaking of the recovery of a condensate

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4781 of which 40 to 70 per cent will be as high boiling as the

original oil, I wish it to be understood that I mean the
40 to 70 per cent of high boiling oil recovered will be as
high boiling as the oil that could be produced by condensing
the vapors entering the cracking zone. This is for the stated
reason that sometimes the oils which I use to produce the vapors
crack down in the vaporization and the vapors are therefore of
oils lighter than those charged to the vaporizer.

As stated, cracking always occurs when hydrocarbons
are heated, heavier and higher-boiling oils being converted
into lighter and lower boiling products; this change occurring
whether the hydrocarbons be heated as vapors or as liquids.
For practical purposes, insofar as the type of cracking here
interesting is concerned, the influence of pressure is negligible
and any degree of pressure greater than atmospheric is undesirable; and particularly any degree which would tend to restrain
vaporization of liquid hydrocarbons. The degree of temperature
attained by the hydrocarbon is a much more important factor;
but in the present invention this factor is automatically controlled by the simple expedient of always keeping an excess of
oil vapors in the cracking zone. Cracking probably takes place
at all high temperatures to some extent; but this extent is not
important, with most oils, below about 600° F. and does not
become energetic below, say, 700° F. At a range between 1100°

and 1300° F., it is energetic and far-going, tending to resolve
all oils into permanent hydrocarbon gases; while at temperatures
still higher, these gases in turn break down. Between 600° and

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4782 700° F. all the petroleum oils vaporize or yield vapors
(by cracking) while in this temperature range all the products
here sought are vapors. In attaining temperatures over 600°
F. and in cracking, heat of course must be furnished; but most
of this heat is that required for vaporization (or vaporization
with cracking), the amount required for the cracking of the
vapors being, comparatively, little. For this reason in an
embodiment of the present process wherein vapors are taken
directly from a still in the course of the ordinary distillation represents an important economy of heat, it being then
necessary only to furnish the slight amount of heat required
for cracking. With the use of substantially dry vapors, that
is vapors free from any substantial amount of liquid, it is
easier to furnish a controllable degree of heat since it is not
then necessary to allow additional heat for vaporization.
This desirability of dry vapors in the cracking operation is one
of the reasons for not using pressure, the influence of pressure
being, of course, to restrain or prevent vaporization or to
reliquefy vapors.

Since I am merely passing oil vapors through a hot
tube and thence to a condenser without the use of complicated
apparatus or processes my method lends itself readily to inter-
calation or interposition in the ordinary methods of oil dis-
tillation as practiced in this country. For example, in
distilling a crude oil the vapors from the still may be sent
directly to the ordinary air-cooled condensing or dephlegmating
tower and thence to water cooled condensers as long as the
natural gasoline and burning oils are coming over and then

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4783 at this time be by-passed through the cracking tube, the vapors
coming from the cracking tube being then sent to the succession
of condensers stated. The oil coming from the tower may be
drained back directly into the still. Or the transmission of
vapors directly to the tower and condenser may be interrupted
at the time when the natural gasoline has come over and the
following vapors of burning oil may be by-passed via the crack-
ing tube on their way to the condensers. By provision of a
cracking tube on a by-pass conduit between the still and the
condensers the cracking operation may be used at any stage
in the ordinary distilling processes.

I ordinarily use a succession of condensers of two
different types. The first condenser, which may be air cooled

or water cooled as the case may be, I maintain at a high temperature; a temperature such that high boiling oils passing through the cracking zone will be here condensed but without much condensation of gasoline. The second condenser is the ordinary water cooled type adapted to condense gasoline. The temperature at which the first condenser is to be used will of course depend upon the nature of the oil being cracked; it being maintained at a much lower temperature when kerosene is the oil undergoing the cracking than when a higher boiling oil is treated. Ordinarily, I use a common type of dephlegmator for the first condenser. In the case of high boiling oils particularly, air cooling may be sufficient; but if necessary, as is often the case in cracking kerosene, I may also water-cool.

The material delivered by the second condenser is applicable

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4784 for use as a motor fuel. Ordinarily its amount added to the amount of condensate in the first condenser should be at least 90 per cent of the total amount of oil vaporized; that is there should not be as much as 10 per cent disappearing as gas, tar and coke. The amount of condensate produced in the final condenser can of course be varied by control of conditions in the primary condenser. Ordinarily with 50 per cent of the

oil recovered in the primary condenser the gasoline coming from
the final condenser will have an end dry point under 400° F.
With 40 per cent recovery in this primary condenser the end
dry point of the gasoline will be 430° F., while in producing
the gasoline of an end dry point of 450° F. there may be only
30 per cent recovered in the air cooled condenser.

The oil recovered in the primary condenser may be
sent directly back to the still or vaporizing device and
ordinarily is so sent.

A further portion of light gasoline may be obtained
by scrubbing the gases passing beyond the final condenser with
the aid of a little heavy oil. The gasoline is absorbed by
the heavy oil and may be regained by distilling it off, the
exhausted wash oil being then sent back for reuse. Or, the
oil which is to be sent to the vaporizing device for furnishing
vapors to pass through the cracking tube may be used in this
scrubbing operation, being sent through the scrubbing device
to recover gasoline vapors and being then sent directly to
the still.

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4785 — In producing very light, easily volatile gasolines for aeroplane engines, dry cleaning clothes, etc., it is a
useful expedient to scrub in the primary condenser as well.
The vapors in this condenser are hot and on contact with a
little scrubbing oil they give up to it only high-boiling

bodies. Where the condensate from the primary condenser is
sent back to the still (as it may be), the scrubbing oil used
therein may be the fresh oil to be supplied to the still.

In the accompanying illustration I have shown, more or less diagrammatically, apparatus adapted for use in
the described process.

Figure 1 is an elevation partly in section of a simple type of apparatus;

Figure 2 is a similar view of an apparatus enabling
utilization of the present process in distillation at any
stage of such distillation;

Figure 3 is a top plan view of the apparatus similar
Per A to that shown in Figure 2 wherein a plurality of units *(IS) ~~are~~
employed;

Figure 4 is a top plan view of another form of apparatus in which continuously operating batch stills are
used with means for diverting vapors at any desired time to
a cracking apparatus under the present invention;

Figure 5 is a diagrammatic elevation of an apparatus
wherein oil to be vaporized is used for scrubbing in a
primary condenser; and wherein two primary condensers in
series are employed;

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4786 Figure 6 is a similar view illustrating means for feeding the vapors either to the top or the bottom of the
cracker; and

Figure 7 is a modified type of apparatus similar to
that of Figure 5.

* Matter in parentheses inserted.

Figure 8 is still another type of apparatus which
may be employed in performing this process.

Referring to the drawings, element 1 indicates conventionally a petroleum still of any well known or suitable
type, provided with vapor exit 2 in communication with the
cracking tube 3 (here shown as horizontal or slightly inclined)
passing through and surrounded by a suitable heating jacket 4
by the aid of which such cracking tube may be maintained at
any temperature desired, such as a red heat. Any suitable
firing means may be employed for this heating chamber; and
there are diagrammatically shown inlet 5 for flame and flame
gases and outlet 6 for products of combustion. The cracking
tube 2 is in communication with a primary condenser 7 at or
near the bottom. As shown, this primary condenser is of an
ordinary air cooled type. In treating high boiling oils with
a primary condenser of sufficient surface, additional means
of cooling may not be necessary. If additional cooling is
desired, it may be furnished as by the cooling coil 8 in
which water is admitted at 9 and discharged at 10. As shown,
temperatures at the top of the tower may be read by the aid
of thermometer 11. The vapors of high boiling oils passing
through the cracking zone unchanged are condensed in this
column and, as shown, are returned to the still while hot

by trap conduit 12 for revaporization. Uncon-
densed vapors
leave the top of the tower through conduit 13
and go thence

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4787 to a final condenser 14; here shown as of a simple
water
cooled type. Condensed liquids flow to receiving
tank 15
whence they may be removed at outlet 16. Un-
condensed gases
may be led to a scrubber or point of use through
17.

In Figure 2 is shown a more complicated struc-
ture
in which vapors coming from a still may be sent
either to a
cracking device or directly to a condenser, which
in this case
has the same function as the final condenser of
the figure
just described. The structure is useful in a
method of dis-
tilling crude oil wherein first gasoline and kero-
sene naturally
contained are directly distilled and removed and
thereafter
vapors are sent through a cracking tube. In this
showing
element 18 is a conventionally shown petroleum
still having
firing chamber 19. From the top of the still
passes vapor
conduct 20 connecting with two valved pipes, re-
spectively, 21
and 22. Conduit 21 leads to a simple reflux con-
denser 23 having
a trap return 24 leading back to the still. From
the top of
Per Ex Am this reflux condenser uncondensed vapors pass
through *(PIPE) 25 to an
ordinary water cooled condensing device 26. Con-
densed gasoline

Per A or kerosene *(18) ~~are~~ removed at 27. The other vapor conduct (22) leads directly to a cracking device. As shown the vapors enter at the bottom of a heated vertical cracking tube 28 and pass upward therethrough. Surrounding the cracking conduit is a furnace chamber 29. The vapors of cracked products mixed with vapors of uncracked oil pass off at the top of the cracking tube through pipe 30 and thence to primary condenser 31. There are some advantages in passing the vapors upwardly through a

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4788 vertical cracking tube but they may of course be passed downwardly if desired. To this end, there may be provided an alternative conduit 32 leading the vapors to the top of the cracking conduit. Cracked and uncracked vapors may then be removed from the bottom of the cracking tube through 33 and go thence to the primary condenser. Passage of vapors through these conduits may be controlled, respectively, by valves 34 and 35. From the primary condenser uncondensed vapors (gasoline or motor fuel) pass through conduit 36 to a water cooled final condenser 37 while condensed products pass from the bottom of the primary condenser through the cooling box 38. If desired, instead of sending the condensate from the primary condenser through the cooling box for such disposition as may seem proper,

* Matter in parentheses inserted.

the hot liquor from the bottom of the primary condenser may be returned directly to the still by means of valved conduit 39.

In Figure 3 the elements similar to those of Figure 2 have the same reference numerals. This figure illustrates a plurality of stills such as that of Figure 2, all capable of supplying vapors to a common cracking device. To this end, the vapor outlet which in Figure 2 leads directly to a cracking device here communicates with a cross pipe 40 which in turn has connection through 41 with a battery of cracking tubes similar to the cracking tube of Figure 2. The battery of cracking tubes in turn communicates with primary and final condensers in the same manner as in Figure 2. The condensate from the primary condensers may be delivered through pipe 42 and cross pipe 43 to any of the stills. As in Figure 2, each of the stills is provided with a directly connected condenser

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4789 (final condenser). By this arrangement, presuming the plurality of stills are operating out of phase, one or more of the stills may always be furnishing vapors for cracking to the cracking tube while other stills are performing preliminary distillation; the removal of the natural gasoline and kerosene of the crude oil. The oil may be supplied to

the plurality of stills through the inlet pipe 44 leading to
a preheater 45, from which any light vapors are passed through
Per A pipe 46 to a dephlegmating tower 47 and ~~from~~ thence through
pipe 48 to a condenser or cooler 49. Liquid oil leaves the
base of the dephlegmating column 47 and is conducted to any
one of the plurality of stills through the valved line 50.
Pump 51 may be provided for delivering the oil through the
preheater to the stills and pump 52 may be provided for returning to the stills hot heavy oils which are not passed to
the cooling box 38.

In the apparatus of Figure 4 a description of the
operation will suffice to identify the different elements.
Per A The oil enters through pipe 53 to a preheater 54 ~~from~~ whence
it is conducted by line 55 to the dephlegmator 56, the vapors
therefrom being sent to a condenser 57 through pipe 58 and
from such condenser as liquids through pipe 59 to the receiving
means 60. The heated liquid from the dephlegmating column 56
is fed by means 61 to any one of a plurality of stills
operating in parallel or in series. Ordinary distillation
takes place in these stills, the kerosene, gasoline or other
light vapors being conducted to condensers 62 by means of the

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4790 pipes 63. After the preliminary distillation in these

stills the heavy oils are conducted by pipe 64 to a plurality
of cracking stills (four being shown) which may be run in
series or parallel. The vapors from these stills are conducted
by means of pipes 65 to cracker 66, being delivered into one
of the set of cracking tubes therein by means of the mains 67.
The cracked vapors pass to the preliminary condensers 68
through pipes 69 and from there to the final condensers 70.
The heavy oils from the preliminary condensers 68 pass through
tubes 71 back to the coking stills. The condensed final
product from condensers 70 is delivered by means of pipes 72
to the receiving means 60.

In the apparatus shown in Figure 5 instead of an
ordinary still there is disclosed a vaporizing device 75
to which the desired oil is fed by means of a main 76. This
main leads to pump 77 which delivers the oil through pipe 78
to the top of an interchanger 79, the oil therein contacting
with the vapors from the cracker as hereinafter described.
From the vaporizer the vapors pass by means of pump 80
to the vaporizer which may be heated in any known manner.
From the vaporizer the vapors pass by means of pipe 81 to
the top of the cracker 82 having heating chamber 83 and from
the cracker the cracked products pass by means of the conduit
84 to the bottom of the heat interchanger shown where they are

scrubbed by the incoming oil as just described. From the
top of the heat interchanger these cracked scrubbed products
may be passed by means of the line 85 to the bottom of a
Per A primary condenser 86 ~~from~~ whence uncondensed vapors pass to the

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4791 final condenser 87 and thence by means of line 88 to a
storage tank 89. The condensed products in the primary
condenser 86 are collected in 90 and join the crude or raw
oil which is being delivered to the vaporizer 75.

In the apparatus shown in Figure 6 the crude oil is fed to a dehydrator and preheater 91 by means of the main 92.
The dehydrator and preheater is furnished with hot gases from
Per A the flue 93 leading from the chamber 94 *(OF) ~~to~~ the cracker 95
and these gases are exhausted from the preheater by means of
the fan 96. The oil is fed to the dehydrator and preheater
under pump pressure and is delivered to the top of the
dephlegmating column where the steam is flashed out and con-
ducted away through pipe 97. From this tube the dehydrated
oil is fed by means of pipe 98 to the still 99. The oil in
this still may be given the usual preliminary treatment to
produce gasoline, kerosene and other light oils if desired,
in which event they are passed through pipe 100 directly to

* Matter in parentheses inserted.

the final condenser 101. In event that it is desired to crack
any one of these light oils or the vapors from the heavier
oils after removal of the light oils, they may be passed to
the bottom of the cracker 95 by means of the pipe 102. The
cracked products may pass from the top of the cracker through
pipe 103 to the bottom of the primary condenser 104, condensates
therefrom being returned to the still through pipe 105. The
vapors from the primary condenser may pass to the secondary
condenser through the passage 106. In event it is desirable to
pass the product from still 99 to the top of the cracker, this

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4792 may be done through line 100 connected to the cracker
at 107. In this event the vapors are delivered from the
cracker through pipe 108 to the primary condenser. It is
obvious that the vapors may be passed directly to the
primary condenser or to the bottom or the top of the cracked
by proper manipulation of the valves in the line.

Figure 7 shows an apparatus quite similar to that
of Figure 5, except that a still 109 is used in the place
of the vaporizer 75 shown in Figure 5. The same elements
designate corresponding parts and the operation is the same.

In Figure 8 of the drawings I have shown an apparatus

particularly applicable for use in the present process wherein
crude oil is stripped by the aid of the cracked vapors, this
oil being fed to the exchange tower 110 through pipe 111, by means of
pump 112. Heat exchange and evaporation and condensation take
place in the exchange tower, certain products such as gasolines,
kerosenes, solar oils and gas oils being vaporized by the vapors
from the cracking tube 113. The heavy fractions or residuum of
the crude oil together with the heavy oils condensed from the
per A cracked vapors, pass out *(OF) the bottom of the exchange tower through
line 114 to a storage tank, (not shown). Pump 115 is used to
pump the heavy oils to the storage tank. The lighter oils
vaporized in the exchange tower together with uncondensed vapors
from the cracking tube are conveyed from the top of the tower
through pipe 116 to the fractionating tower 117. Fractionating
is accomplished in the fractionating tower by air, water or oil
cooling and the cooling of the tower is so arranged that only
the desired motor fuel remains uncondensed. The uncondensed

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4793 vapors from the fractionating tower are conveyed through pipe
118 to a final condenser 119 and thence to the receiving house.
The vapors condensed in the fractionating tower are conveyed

* Matter in parentheses inserted.

by pipe 120 to vaporizer or still 121 where they are again vaporized. Under usual conditions it is necessary to supply an additional quantity of oil to the vaporized or still. Pipe 121a is used to feed the additional fresh supply of oil. This pipe leads to a source of suitable material. Pump 122a is used to feed this oil to the still. The vapors from the still are conveyed through pipe lines 122 to the cracking tube or tubes and thence through the system in the manner similar to that described in connection with the apparatus shown in Figure 5 of the drawings. The advantages of the apparatus shown in Figure 8, when employed in connection with crude oil are that such oil may be stripped of its lighter constituents by the heat of the vapors from the cracking apparatus thereby economizing heat. The heavy stripped oil removed from the fractionating tower through pipe 114 may be utilized in any suitable way.

The vaporizer shown in this view is a still similar to still 109 shown in Figure 7 but under some circumstances I may employ in lieu thereof such a special vaporizer as the element 75 of Figure 5.

In all the views valves are provided on the lines permitting control of amounts and direction of flow of oil and vapors. This operation is obvious from the above description.

The yield obtained in the several condensers of course
depends largely upon the character of the oil under treatment,

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4794 greater yields of motor fuel being of course obtainable from
kerosene than from heavier oils, such as gas oil and solar oil.
With solar oil and gas oil, ordinarily there will be condensed
in the primary condenser 70 per cent or so of high boiling oil
where gasoline of 400° F. dry point is being made; or about 60
per cent in making a gasoline of 430° dry point. In speaking
of these gasolines, I of course mean the refined products
obtained by steam treating and stilling the secondary condensates. In the rectification of gasoline in the steam still,
a small amount of "heavy ends" is always obtained.

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21

*(1) 8. In the manufacture of low boiling oils from higher
boiling oils, the process which comprises vaporizing such
a higher boiling oil, passing the vapors through a hot tubular
cracking zone at such a rate that only a portion of the vapors
are cracked therein, passing the emerging vapors through an
air cooled condenser and in such a condenser scrubbing with
high boiling oil, returning the mixture of scrubbing oil and

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* Matter in parentheses inserted.

4798 condensed high boiling oil to serve for the production
of vapors for the cracking zone, and condensing the residual
vapors passing the air cooled condenser to give a condensate
of the desired low boiling oils.

~~*11. The process of making gasoline, motor spirits, and the like, from high boiling hydrocarbon oils which comprises passing the vapors of such hydrocarbon oils through a zone heated to 450° C to 700° C at a rate sufficiently rapid to give a large volume of liquid concendate containing a substantial proportion of oils of high boiling as those originally used, fractionally condensing the so treated vapors in such a manner as to separate the desired low boiling hydrocarbons from the contained high boiling hydrocarbons, and returning the high boiling oils for rerunning.*~~

25

4799 ~~*12. The process of making gasoline, motor spirit, benzine, and the like from high boiling petroleum hydrocarbons which comprises passing a mixture of high boiling petroleum hydrocarbons through a heated zone at a temperature of 450° C to 700° C and about atmospheric pressure at a rate sufficiently rapid to leave a substantial proportion of such high-boiling hydrocarbons undecomposed, fractionally condensing the vapors after leaving the heated zone, and*~~

~~*continuously returning the condensed high boiling oils mixed with the original oil through the same cycle.*~~

---

*(3) ~~*14.*~~ In the process of making low boiling petroleum hydrocarbons, such as gasoline, benzine, ligroin, and the like from high boiling petroleum hydrocarbons, such as crude petroleum, petroleum distillates, and petroleum residuums, the process which comprises passing the vapors of such high boiling oils through a heated zone at a temperature of about 500° C. at about atmospheric pressure, and at a rate sufficiently rapid to ensure a substantial portion of such vapors passing

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4800 through unchanged, fractionally condensing the so treated vapors in such manner that the high boiling and unchanged hydrocarbon products are separated from the desired low boiling hydrocarbon product, and continuously returning the high boiling and unchanged hydrocarbon products to be rerun repeatedly through the same cycle of treatment.

~~*16. In the cracking of high boiling oils to produce lower boiling oils, the process which comprises producing dry vapors of substantially atmospheric pressure from a mixture of such a high boiling oil with a recovered oil from a later stage in the process, passing such vapors rapidly through an*~~

---

* Matter in parentheses inserted.

~~unobstructed tubular cracking zone maintained at a suitable cracking temperature, the rate of passage being such that about 60 per cent of the oil so vaporized passes through the cracking zone unchanged, condensing the unchanged portion of oil from the vapors and returning it to make the mixture for producing vapors and condensing the residue of the vapors to obtain the low boiling oils.~~

Insert A[1]>

In testimony whereof I have hereunto affixed by signature this 23 day of November, 1917.

Clive M. Alexander.

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4801 OATH.

State of Texas, }
County of Jefferson. } ss.

Clive M. Alexander, the above named petitioner, being duly sworn, deposes and says that he is a citizen of the United States, and a resident of Port Arthur in the County of Jefferson and State of Texas; that he verily believes himself to be the first, original and sole inventor of the improvements in

Manufacture of Motor Fuels

described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof, or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to this application or his prior application No. 65,249, filed December 6, 1915 of which this present application is a continuation; and that the invention has not been patented to himself or to others with his knowledge or consent in this or any foreign country for more than two years prior to the filing of this or his said prior application, or on an application for a patent filed

in any foreign country by himself or his legal representatives or assigns or by others with this knowledge or consent more than twelve months prior to this or his said prior application; nor have any foreign applications for said invention been filed by him, his legal representatives or assigns, or by others with his knowledge and consent.

Clive M. Alexander.

Sworn to and subscribed before me this 23 day of November, 1917.

H. R. Hudson,

(Seal) *Notary Public in and for Jefferson County, Texas.*

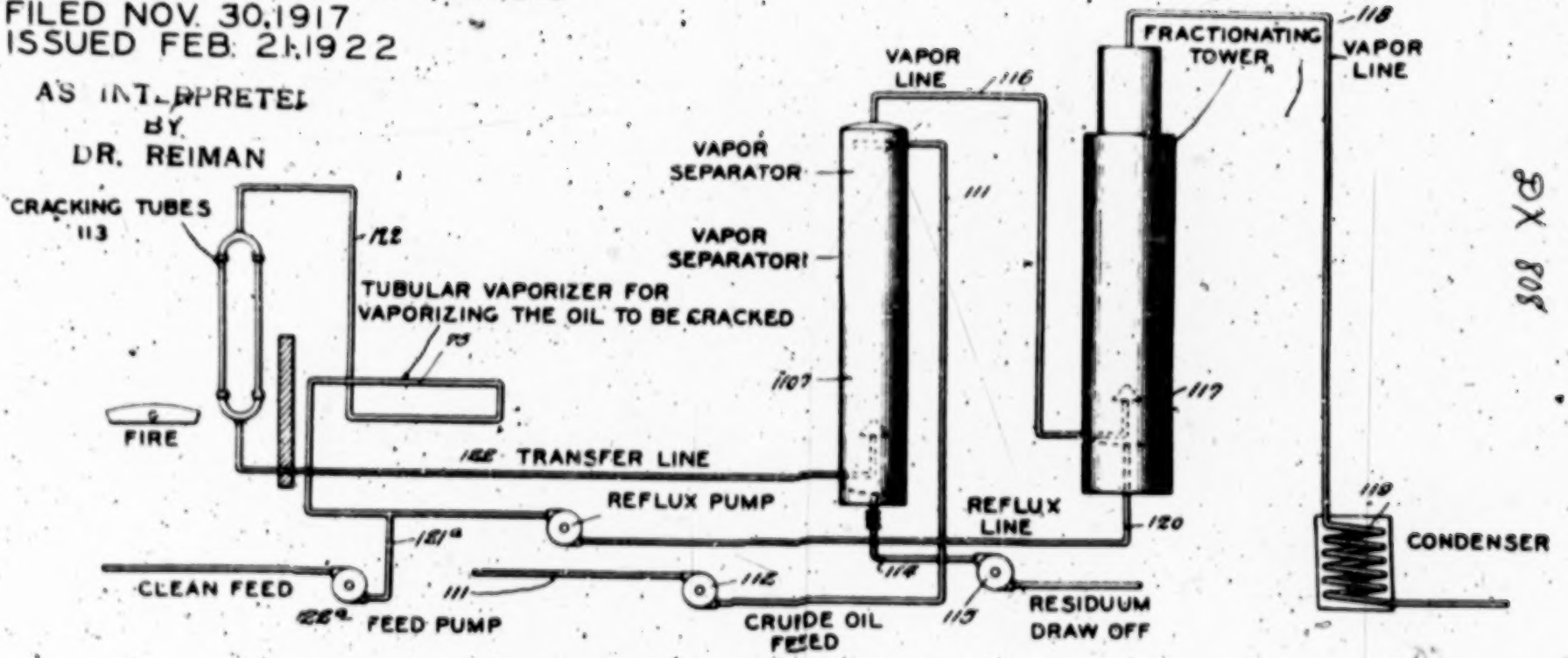
My Commission Expires June 1, 1919.

28

Drawings of U. S. Patents No. 1407619 (see Index) (DX 806).

ALEXANDER PAT. NO 1,407,619
FILED NOV. 30,1917
ISSUED FEB. 21,1922

AS INTERPRETED
BY
DR. REIMAN



THE VAPORIZER 75 THAT CAN BE SUBSTITUTED FOR SHELL STILL 121 (SEE PAGE 6 LINE 95)

THE VAPORIZER SHOWN IN THIS VIEW IS A STILL SIMILAR TO STILL 109 SHOWN IN FIGURE 7 BUT UNDER SOME CIRCUMSTANCES I MAY EMPLOY IN LIEU THEREOF SUCH A SPECIAL VAPORIZER AS THE ELEMENT 75 OF FIGURE 5

808 X 8

2892

4877 DX 810.

390

DEPARTMENT OF COMMERCE.

United States Patent Office

To all persons to whom these presents shall come, Greeting:

This Is to Certify that the annexed is a true copy from the records of the office of the File Wrapper, Contents and Drawings, in the matter of the

Letters Patent of

Charles J. Greenstreet, Assignor to Gasoline Corporation,

Number 1,740,691, Granted December 24, 1929,

for

Improvement in Apparatus and Process of Treating Hydrocarbon Oils.

In Testimony Whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed, at the City of Washington, this twenty-eighth day of October, in the year of our Lord one thousand nine hundred and thirty, and of the Independence of the United States of America the one hundred and fifty-fifth.

Thomas E. Robertson,
Commissioner of Patents.

(Seal)

Attest:

D. E. Wilson,
Chief of Division.

4880

PETITION.

(Stamp) Mail Room Aug 4 1917 U. S. Patent Office.

To the Commissioner of Patents:

Your Petitioner, Charles J. Greenstreet, a citizen of the United States and resident of the City of *(NEW YORK) ~~St. Louis, County of St. Louis,~~ State of *(NEW YORK) ~~Missouri,~~ whose Post Office address is ~~the same~~ *(11 BOARDWAY, SUITE 1133, NEW YORK, N. Y.) prays that Letters Patent may be granted to him for certain new and useful improvements in Apparatus and Process of Treating Hydrocarbon Oils set forth in the annexed specification.

See renewal " "

Your petitioner hereby appoints the firm of Kenyon & Kenyon (Registered No. 2570), composed of Wm. Houston Kenyon, Alan D. Kenyon, and Richard Eyre, of 61 Broadway, New York, N. Y., his attorneys, with full power of substitution and revocation, to present and prosecute this application, to make alterations and amendments therein, to sign the drawings, to receive the patent, and to transact all business in the Patent Office connected therewith.

Signed at New York City this 2nd day of August, 1917.

Charles J. Greenstreet.

SPECIFICATION.

To All Whom It May Concern:

See Renewal paper #31

Be it known, that I, Charles J. Greenstreet, a citizen of the United States and resident of the City of *(NEW YORK) ~~St. Louis,~~ County of *(KINGS) ~~St. Louis,~~ State of *(NEW YORK) ~~Missouri,~~ whose Post Office address is the same have invented certain new and useful improvements in Apparatus and Processes of Treating Hydrocarbon Oils of which the following is a specification:

2

* Matter in parentheses inserted.

My invention relates to the treatment of hydrocarbon oils and particularly to the process and apparatus therefor.

One of the objects of my invention is to reduce the cost of operation of processes for cracking hydrocarbon oils, and is especially useful in reducing the fuel consumption and increasing the percentage of light hydrocarbons recovered with a minimum amount of labor.

One way of accomplishing this result is by heat insulating the passage from the furnace to the exit.

The following description of the process and apparatus taken in connection with the accompanying drawings forming a part hereof, will more fully convey my invention and the manner in which the same is operated.

In the drawings, Fig. 1 is a side elevation.

Per Ex A Fig. 2 is a plan view*(.) ~~and~~

Per A Fig. 3 is an end elevation *(OF THE FURNACE SHOWING THE CONNECTION OF THE VAPOR LINES).

Insert B' (2)

In the drawings, the apparatus comprises a furnace 1, in which are located a plurality of cracking units 2.

The furnace may be of any suitable construction and may be heated by coal or other fuel as desired, the furnace forming no part of the present invention. The cracking units placed in the furnace are so arranged that the passage is a continuous, unobstructed one, preferably consisting of

* Matter in parentheses inserted.

a series of straight pipes of suitable diameter joined
together by semicircular end connections 3.

The equipment shown in the accompanying drawings
comprises six units, each unit comprising a cracking coil
4, 5, 6, 7, 8 or 9, to which is connected a preheater 10.

3

4882 The length of this preheater is such that the oil under
treatment is brought to the vaporizing point just as it
Per A enters the cracking pipe. *(EACH) ~~The~~ preheater is connected to *(A)
" A suitable storage tank 11 from which the supply is taken.
In each pipe line from the storage tank is a steam pump 12
and a meter 13 as well as suitable valves for controlling
the supply. Connected with each cracking unit is a steam
pipe 14, which pipe is so arranged that the steam, before
Per G entering ~~into~~ the cracking unit, is super-heated. This
steam pipe also has suitable valve connections for control-
ling the flow of steam.

There is provided in the furnace a series of crude
Per A oil or distillate topping coils 15 *(, ONE FOR EACH CRACKING UNIT). These coils are shorter in length than the cracking coils and the contents are
therefore subjected to the heat of the furnace a comparatively shorter time than the contents of the cracking coils.

* Matter in parentheses inserted.

It is the purpose of these topping coils to heat the crude oil or distillate preferably above its vaporizing point. The vapors from these coils are conducted through the digester tanks as will be more fully explained later. The heavier fractions are deposited in the various succeeding tanks and the benzine fraction taken off and conducted to a condenser. From each of the cracking coils a vapor line
Per exr 16, 17, 18, 19, 20 and 21 leads to tank*(S) 22. As all of the cracking units are alike, a description of one will suffice for all.

The digester tanks 22 and all other parts of the pipe system and tanks are heat insulated by some suitable com-
Per B pound 23 in any well known manner. *(ALL THE) ~~The~~ digester tank*(S) 22

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4883 *(ARE) ~~is~~ connected by a suitable pipe with a
Per B series of other digester tanks 24, 25, 26, 27, 28, 29, 30 and 31. In each case the pipes connecting the tanks are heat insulated as well as all the digester tanks. The top of each of the
Per G digester tanks *(24 TO 31) is connected to a lower portion of each succeeding tank by connections 32, 33, 34, 35, 36, 37 and 38, and the top of the last digester tank is connected to condenser coils 39, which condenser coils are cooled in any

* Matter in parentheses inserted.

suitable manner. The final product leaves the apparatus
through the pipe ● in the form of benzine, which is con-
Per H ducted to a suitable storage tank *(11—B).
Per B Connected to the bottom of the *(ALL) ~~each~~ of the digester tanks
22 is a header 41 into which the heavier products settle
or condense, and which are not rerun through the furnace.
" " Connected with the bottom of *(ALL) ~~each~~ of the digester tanks 24
" G to 31 inclusive is a header 42 ~~into~~ which the heavier ends
settle out or condense. The header 42 leads to a condenser
coil which is suitably cooled, and this condensed product,
which may be termed an intermediate product is conducted
to a suitable storage tank, from which it is rerun through
the cracking coils.

Located within the last digester tank 31 is a cooling
coil 44 having an inlet 45 and an exit 46. Through this
pipe, water or other suitable cooling fluid can be conducted
so as to regulate the temperature of the last of the di-
Per C gester tanks. ~~*In some instances, I prefer to conduct the*~~
~~*oil under treatment through this coil so as to preheat it*~~
~~*before connecting it with the preheater coils in the fur-*~~
~~*nace.*~~ The tank 31 is provided with a thermometer so that the
temperature may be suitably indicated. Each of the digester

5

* Matter in parentheses inserted.

4884 tanks is provided with a pressure guage so that the pressure
may be observed. This pressure is controlled by a valve
47 which is connected to the last of the digester tanks.

Each of the digester tanks into which the individual
cracking units or the vapor lines terminate, is connected
with a header 48, which in turn is connected with the first
of the series of digester tanks 24 to 31. Each of the con-
nections from the digester tanks to the header 48 is pro-
vided with a valve 49. These valves are for cut-
ting out a
cracking unit in case of accident.

While I have shown the apparatus arranged so that
there is only one series of digester tanks, I wish it to
be understood that my invention contemplates the use of a
series of tanks for each cracking unit, in which event each
Per H digester tank 22 would connect direct*(LY) with its own series of
digester tanks. In the header 48 opposite the connection
Per A to the digester tanks is a plug *(51) for steam connection, which
would permit the application of a steam pipe at this point
for the purpose of blowing steam through the digester tanks
for the removal of impurities. Each end of the header 48
" A is provided with a steam plug *(52). ~~*The vapor*~~
Per B ~~*lines leading to*~~
~~*the digester tanks 22 are also provided with*~~
~~*means whereby*~~

---

* Matter in parentheses inserted.

Per G ~~steam may be injected to prevent any burning of the oil in the vapor lines.~~

Each of the vapor lines leading from the cracking coil to the digester tanks 22 is provided with a pyro-
per B meter *(53). The
" G header leading to the digester tanks *(24 TO 31) is provided with a
Per B suitable draw*(-OFF) valve 50. ~~The vapor lines are also provided with suitable draw-off valves as well as with blow-off valves for the purpose of cleaning out any residue.~~

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4885 It is understood that all of the connections from the
Per B furnace to the very end of the series of digester tanks *(ARE) ~~is~~ thoroughly heat insulated, so that the heat given to the oil in the furnace is conserved and kept within the piping
Insert F' system with as little loss as possible. *(F') (11)

The operation of the apparatus is as follows:

Per B The crude oil ~~or distillate~~ is first run *(FROM THE TANK 11A) through the topping coils and during its course through these
" " coils *(15) which are located in the furnace is heated to at least a point above the vaporizing point of the benzine fraction. These
" " vapors are then conducted *(THROUGH THE VAPOR LINES 15') to the digester tanks 22 and from
Per B these tanks *(INTO THE HEADER 48 AND THENCE) successively through the series of digester tanks 24—31. During the above defined course, the tars or

* Matter in parentheses inserted.

asphalts settle out in the digester tanks 22 and the vapors

Per B continue on down through the series *(OF TANKS 24—31), ~~each tank successively~~

" " ~~containing a *(CONDENSED) portion of the heavier ends *(OF) to the last *(PRECEDING) tank,~~

Sub C[1] C[1]

Per B *(THE LAST TANK) ~~which~~ contains only ~~the~~ benzine vapors, which are thence

" " led to the *(TANK 11B) ~~condenser coil 39.~~ The condensed products which

" " are led into the header 42 are then conducted *(THROUGH PIPE 42) to the dis-

Per B tillate storage tank *(11). The oil is conducted from the stor-

" " age tank *(11) into the preheater *(COILS 10) and is vaporized approximately upon leaving the preheater. It is then conducted in vapor

" " form and accompanied by steam through the cracking coil*(S 2) where it is heated to a high temperature under pressure. Usually, in starting the apparatus, steam is blown through for some suitable length of time before the oil is admitted to the cracking coil. From the cracking coil, the vapors are conducted to the digester tanks 22, and from these

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4886 tanks they are conducted through a passage of comparatively small diameter into the first of the series of digester tanks, 24—31, and from this point, the vapors pass suc-

Per B cessively from tank to tank *(AS ABOVE EXPLAINED) ~~through pipes of suitable size.~~

*Matter in parentheses inserted.

Per B ~~*The vapors are therefore carried from the cracking coil through a passage in which they are successively subjected*~~

Per A ~~*to adiabatic expansion and compression.*~~

By the use of the process as above described, the heavier fractions, which are not transformed into lighter fractions in the cracking coil, due to the rapid velocity of the contents through the cracking coils, are converted into lighter fractions during the course of the vapors through the various digester tanks, so that upon leaving the digester tanks, an unusually large percentage of the oils is transformed into lighter hydrocarbons and due to the heat insulated passage through which they are conducted, the fuel consumption for heating the oil under treatment is greatly reduced and due to the prolonged exposure of the

Per G particles to a high temperature *(WHILE UNDER) ~~*and a uniform*~~ pressure, the unusually large conversion above mentioned is accomplished.

The topping coils can also be used as cracking coils by running an excess of super-heated steam through the

" H topping coils and running the distillate *(MORE) slow*(LY) ~~*er*~~ through the topping coils, in which event a substantial increase in percentage of benzine would result.

Per G In practice, I have found that *(WHEN, AS SHOWN, ABOUT EIGHT TANKS ARE USED) the last three or four

---

* Matter in parentheses inserted.

tanks would act in the capacity of a fire still, the heat
in the tanks being higher than the volatilizing point of
the benzine causes a distillation from these tanks over to

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4887 the last tank, so that the distillates separating out in
the last three or four tanks contain no benzine and should
the last tank contain too much of the heavy ends, due to
the benzine carrying over mechanically some of the heavy
ends distilling, the cooling coil in the last tank serves
to precipitate out the heavy ends, and the benzine vapors
pass into a condenser coil and thence to a run-down tank
ready for further treatment in the usual manner of handling
benzine.

While I have described the apparatus and process in
more or less detail, I desire to have it understood that
I am not limited to the exact arrangement shown. For in-
stance, while the digester tanks, 24—31 have been shown in
a plane above the digester tanks 22, all of these tanks
may be located on the same level, and various other changes
of similar character may be made without in the
Per Exr least *(DE)part-
ing from the spirit of my invention.

Per B ~~*I have found in practice that tanks 24, 25 and 26 con-*~~

* Matter in parentheses inserted.

~~tain a very superior lubricating stock entirely free from~~
Per A ~~paraffin or~~ †[~~other~~] ~~carbon~~†[~~s~~].

While the apparatus above described, shows no application of external heat, other than in the furnace, it is to be understood that I may, nevertheless, add some heat to the piping system at suitable points, if desired.

9.

4888 Having described my invention, what I claim as new and desire to secure by Letters Patent is:

*(F[6] follows)

Sub D[1] ~~1. The process of converting heavier into lighter hydrocarbons which consists in heating said heavier hydrocarbons under pressure to cracking temperature and conducting the heated vapors successively into a series of heat~~
Per A ~~insulated tanks wherein a cracking temperature *(AND PRESSURE ARE)~~ †[~~is~~] ~~maintained.~~

~~2. The process of converting heavier into lighter hydrocarbons which consists in conducting the oil under treatment through a highly heated passage and conducting~~
" A ~~the same thereafter *(UNDER PRESSURE) through a heat insulated passage in which the conversion is continued.~~

~~3. The process of converting heavier into lighter hydrocarbons which consists in conducting the oil under~~
" A ~~*(PRESSURE)~~ †[~~treatment~~] ~~through a highly heated passage, and conducting~~
" A ~~the same thereafter *(WHILE UNDER PRESSURE) through a heat insulated passage in which~~

* Matter in parentheses inserted.
† Matter in brackets precanceled.

the conversion is continued by the contained heat in the oil.

4. The process which consists in heating hydrocarbon oil to cracking temperature *(UNDER PRESSURE), conducting the same successively through a series of tanks and from tank to tank through a relatively small passage while conserving the contained heat of the oil to continue the transformation of the same into lighter hydrocarbon oil.

A

5. The process of treating hydrocarbon oil which consists in initiating the cracking thereof by subjecting the oil under pressure to a high temperature and conducting the same slowly through a †[long] heat insulated passage wherein the cracking is continued.

Per C

6. The process of treating by hydrocarbon oil which consists in subjecting the oil in vapor state to a high temperature for a short time and thereafter conducting the oil through *(RELATIVELY) small*(ER) and large*(R) passages successively while conserving the contained heat thereof to further crack the oil.

Per C

†[7. The process of treating hydrocarbon oil which consists in heating said oil to cracking temperature and conducting it under pressure through a series of heat insulated expansion chambers to further crack the oil.]

Per B

*(7) †[8]. The process of treating hydrocarbon oil which

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4889

* Matter in parentheses inserted.
† Matter in brackets precanceled.

~~consists in subjecting the oil under pressure to a high~~
~~temperature so as to do the larger portion of the cracking~~
~~and conducting the oil through a series of heat insulated~~

Per B †[~~expanson~~] ~~tanks to which no extraneous heat is added to~~
~~further crack the oil.~~

~~*(8)~~ †[~~9~~]: ~~The process which consists in subjecting hydro-~~
~~carbon oil under pressure to a high temperature for an~~
~~appreciable time and thereafter conducting said oil through~~
~~a~~ †[~~long~~] ~~heat insulated passage~~ ^ C²:

Insert C²

~~*(9)~~ †[~~10~~]: ~~The process which consits in subjecting hydro-~~
~~carbon oil under pressure to a high temperature for an~~
~~appreciable time and thereafter conducting said oil through~~
~~a series of heat insulated tanks.~~

~~*(10)~~ †[~~11~~]: ~~The process which consists in vaporizing hydro-~~
~~carbon oil and subjecting said vapor under pressure with~~
~~steam to a high temperature and thereafter conducting said~~
~~vapor under pressure through a heat insulated passage.~~

~~*(11)~~ †[~~12~~]: ~~The process which consists in vaporizing hydro-~~
~~carbon oil and subjecting said vapor under pressure with~~
~~steam to a high temperature and thereafter conducting said~~

11

4890 ~~vapor through a series of heat insulated tanks.~~

~~*(12)~~ †[~~13~~]: ~~The process which consists in vaporizing hydro-~~

---

* Matter in parentheses inserted.
† Matter in brackets precanceled.

~~carbon oil and subjecting said vapor under pressure with~~
~~steam to a high temperature and thereafter conducting said~~
Per B ~~vapor through a series of~~ †[~~expansion~~] ~~chambers connected by~~
~~passages of relatively small diameter.~~

Per A †[~~14. The process which consists in subjecting~~ ~~*(HYDROCARBON)~~ †[~~said~~]
" A ~~oil under pressure and in vapor form to a high temperature~~ ~~*(AND TO PRESSURE)~~
Per B ~~and subsequently to a series of~~ †[~~adiabatic~~] ~~expansions and~~
" A ~~contractions.~~
~~15. The process which consists in cracking a hydrocarbon oil and subsequently purifying said oil by the cracking heat.~~]

~~*(15)~~ †[~~16~~]: ~~The process of treating hydrocarbons which consists~~
Per C ~~in partially cracking their vapors under pressure in a~~ †[~~long~~]
" " ~~heated passage and effecting further cracking in a~~ †[~~long~~]
~~unheated but heat insulated passage, wherein said vapors~~
Per B ~~are still under suitable~~ ~~*(TEMPARTURE AND)~~ ~~pressure for cracking.~~

D ~~*(9 14)~~ †[~~17~~]: ~~The process of treating hydrocarbons which consists~~
Per C ~~in partially cracking their vapors under pressure in a~~ †[~~long~~]
~~heated passage wherein steam is flowing with them, and effecting further cracking in~~ ~~*(AN)~~ †[~~a long~~] ~~un-~~
Per C ~~heated but heat insul-~~
Per D ~~ated passage~~ ~~*(S)~~ ~~wherein said vapors are still~~
" F ~~under suitable~~
Per B ~~*(TEMPARTURE AND)~~ ~~Pressure from cracking~~ ^ .
Per H

Insert G^5 G^5

---

* Matter in parentheses inserted.
† Matter in brackets precanceled.

~~18. In apparatus for treating oil, the combination of a cracking pipe, means for heating said pipe, and a~~
Per A ~~series of heat insulated expansion tanks connected with said cracking pipe.~~

D Sub C' ~~*(19 16 18)~~ †[~~19~~]: ~~In apparatus for treating oil, the combination~~

12

4891 ~~of a series of cracking pipes, means for heating said pipes,~~
~~a series of heat insulated expansion chambers connected with each cracking pipe, means connecting said series of chambers~~
Per C ~~together~~ †[~~and~~] ~~a valve controlling the pressure in all of said tanks~~ ~~*(AND MEANS FOR INJECTING LIQUID INTO SAID TANKS).~~

Insert B²>

~~20. In an apparatus for treating oil, the combination of a cracking pipe, means for heating said pipe, a series of expansion chambers connected with said pipe, and means~~
Per A ~~connecting the upper portion of each tank with the lower portion of the succeeding tank.~~

13

4892 In Testimony Whereof, I have signed by name to this specification.

Charles J. Greenstreet.

* Matter in parentheses inserted.
† Matter in brackets precanceled.

OATH.

State of New York }
County of New York } ss.

Charles J. Greenstreet, the above-named petitioner, being duly sworn, deposes and says that he verily believes himself to be the original, first and sole inventor of the certain new and useful improvements in Apparatus and Process of Treating Hydrocarbon Oils described and claimed in the annexed specification; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof, or that the said invention was ever patented or described in any printed publication in this or any foreign country before his invention or discovery thereof; that no application for a foreign patent for the said invention has been filed or caused to be filed by him or his legal representatives or assigns in any foreign country; that the said invention has not, to his knowledge and belief, been in public use or on sale in the United States, or patented or described in a printed publication or patent, more than two years prior to this application, and that he is a citizen of the United States and a resident of the City of St. Louis, County of St. Louis and State of Missouri.

Charles J. Greenstreet.

Subscribed and sworn to before me this 2nd day of August, 1917.

Edwin Seger,
(Notarial Seal) *Notary Public Kings County.*
Certificate filed in New York County.

14

4893 2—260

Div. 31 Room 169.

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name.

Paper No. 2.

All communications respecting this application should give the serial number, date of filing, title of invention, and name of the applicant.

DEPARTMENT OF THE INTERIOR

United States Patent Office

Washington.

(Stamp) U. S. Patent Office Aug 20 1917 Mailed.

August 20, 1917.

Kenyon & Kenyon,
61 Broadway,
New York City.

Please find below a communication from the Examiner in charge of the application of Chas. J. Greenstreet, No. 184,379, filed Aug. 4, 1917, Apparatus and Process of Treating Hydrocarbon Oils.

Thomas Ewing,
Commissioner of Patents.

The following references are made of record:

Leffer, French	16,360,	Addition to patent 439,476, Aug. 19, 1912, 196-25,
Benton,	342,564,	May 25, 1886, 196-25,
Hall,	1,175,909,	Mar. 14, 1916, "
"	1,175,910,	" " " "
Strache et al.	1,205,578,	Nov. 21, 1916, "
Gray,	1,158,205,	Oct. 26, 1915, 196-26,

In the drawing a section line 3-3 should appear on Fig. 2 to indicate where Fig. 3 is taken. The drawing is not clear as regards the connections of the topping coils with the other pipes. Also, the pipes in Fig. 3 are not sufficiently numbered to furnish means of comparison with other views.

Pipe 15 at the top (near 14) appears to have no connection with 15 at the bottom (near 9); if these are different pipes this should be indicated by the use of different reference numbers.

The Examiner is disposed to question the operativeness of the apparatus: While perhaps the operation may take place to a certain extent in 22, yet the omission of means for supplying heat to 22, as Leffer does to his chamber P, would correspondingly lessen the action in applicant's chamber 22, and it is seriously questioned whether any such action as alleged could occur in the succeeding chambers, 24, 25, etc.

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4895 D. U. Call,
Examiner.

Ast.

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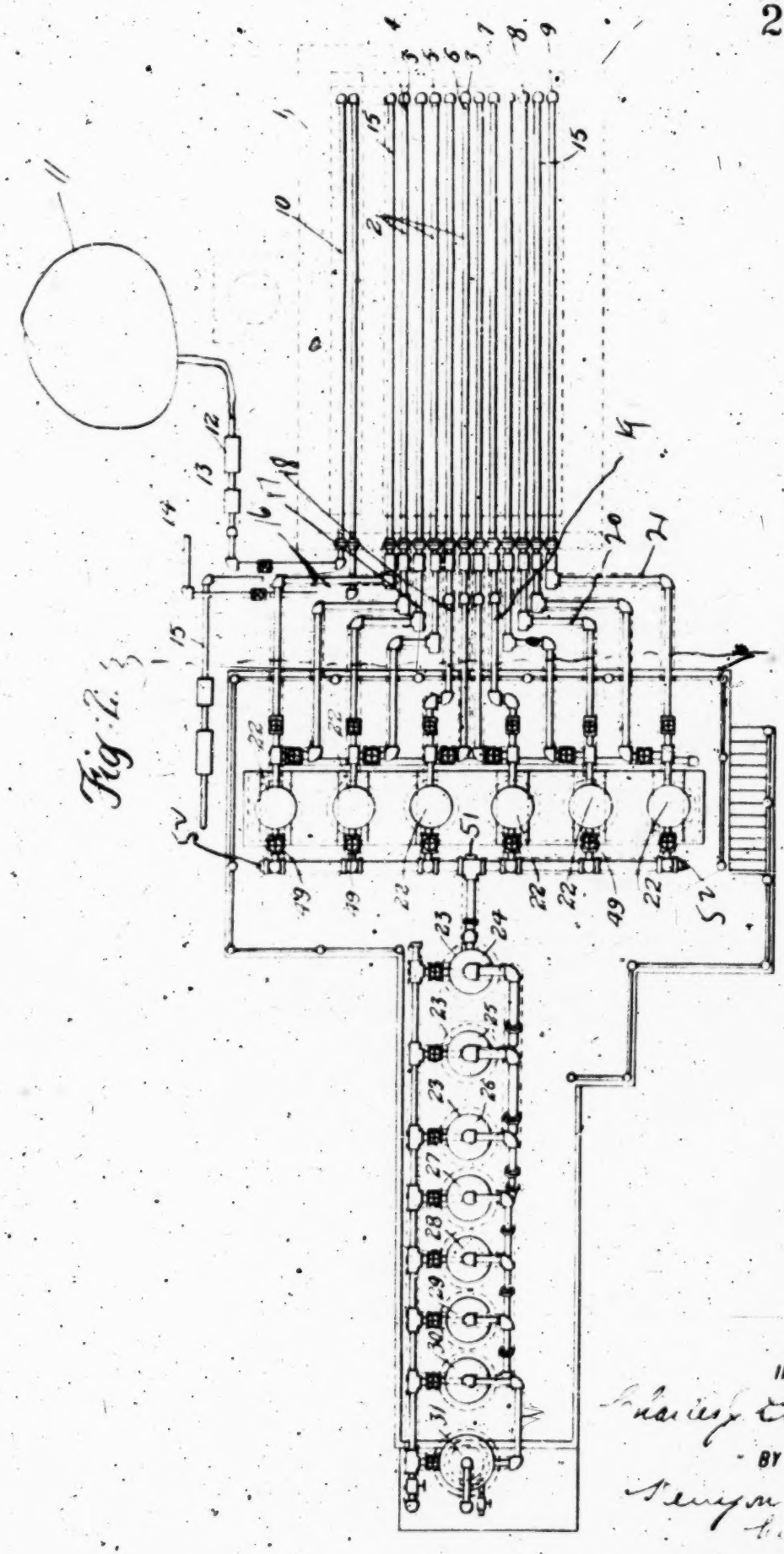

Fig. 2.

INVENTOR
Charles Lemistre
BY
Benjamin Benjamin
ATTORNEYS

2921

2923

INVENTOR
Charles J. Tremaine
BY
Kenyon & Kenyon
ATTORNEYS

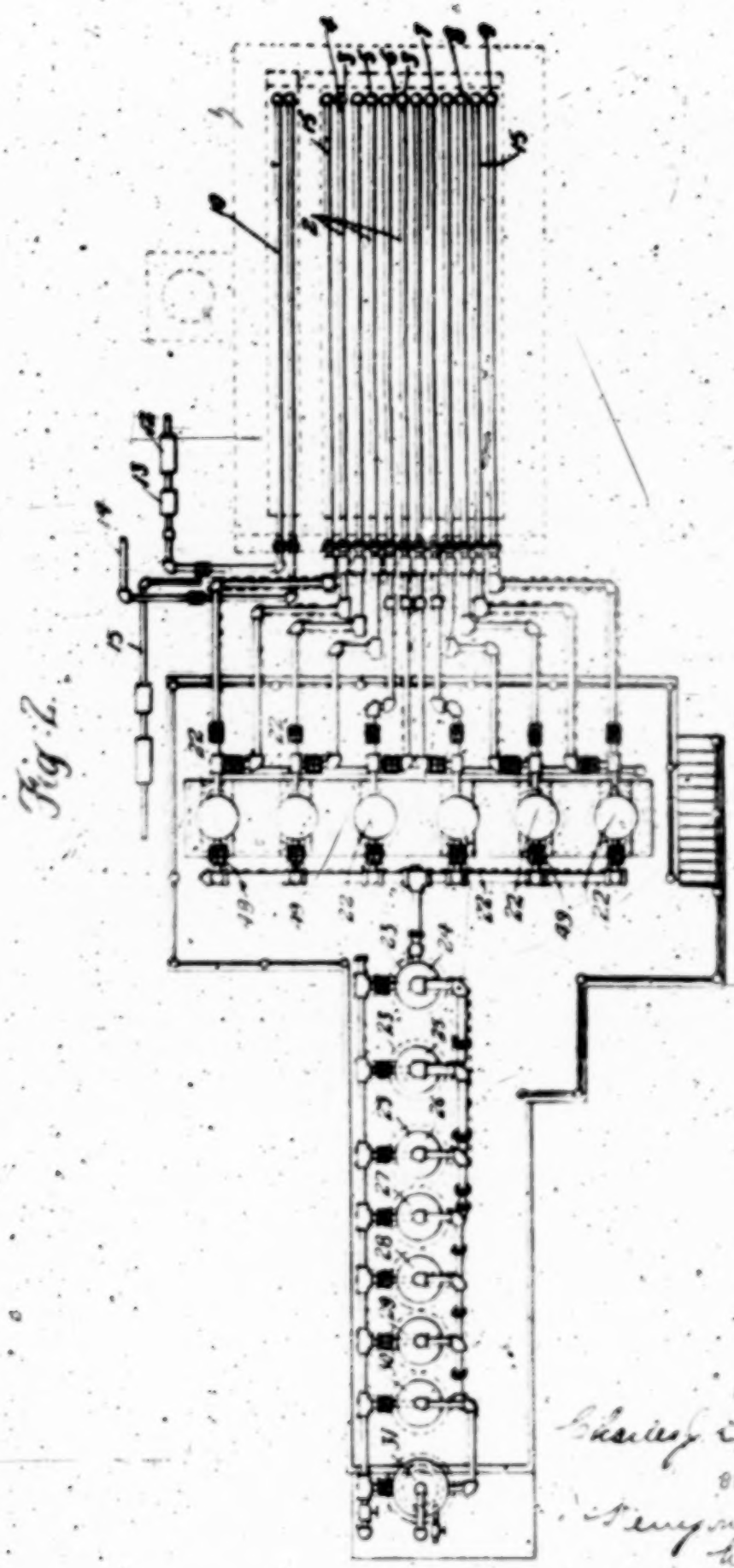

Fig. 2.

INVENTOR
Charles Simmons
BY
Fenyo & Fenyo
HIS ATTORNEYS

4908 2—260

Div. 31 Room 169

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name.

Paper No. 4

All communications respecting this application should give the serial number, date of filing, title of invention, and name of the applicant.

BR/AMT

DEPARTMENT OF THE INTERIOR

United States Patent Office

Washington.

(Stamp) U. S. Patent Office Nov. 19 1918 Mailed.

November 19, 1918.

Kenyon & Kenyon,
61 Broadway,
New York, N. Y.

Please find below a communication from the Examiner in charge of the application of Charles J. Greenstreet, filed Aug. 4, 1917, serial No. 184,379, Apparatus and Process of Treating Hydrocarbons.

James T. Newton,
Commissioner of Patents.

No response having been made relative to the question of inoperativeness, all claims are now rejected on the ground that the apparatus is not operative, as described.

No means for heating the digesters is noted.

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4909 Applicant's process appears to involve what might be termed a "first pass" of the oil via his "topping coils", and then through a series of digesters to separate the heavier constituents, this to be followed by a "second pass," in which the resultant benzine condensate (first taken to a storage tank which, with its connections, should be shown on fig. 2) is conducted, with steam, through the

same preheater, then through a cracking coil, and then through the original series of digesters. Whether or not this is correct, the statements of operation on page 6 should

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4910 be clarified, and the showing and description should be improved by the addition of further reference characters, especially on fig. 1, and by a consecutive mention of the successive pipes through which the oil in each case passes before reaching the digester 22. It is noted that applicant proposes to re-run the residues taken off through 41 and 42. The route and condition of such re-running should have been stated and all connections therefor should be shown on fig. 2. What are the functions of the various valves, including the large valve whose handle extends near to electric wires, shown on fig. 1? And what is the electrical device referred to?

It is left wholly uncertain what connections would be employed or what conditions would be observed in the practice referred to in the last paragraph completed on page 7, or in the next to the last paragraph on page 8. These paragraphs should be canceled, for they could not be made to convey actual information without exclusive reliance upon new matter.

32

4911 G. A. Lorett,
Examiner.

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4913 Paper No. 6.

(Stamp) Mail Room Nov 18 1919 U. S. Patent Office.

UNITED STATES PATENT OFFICE.

In Re Application of Charles J. Greenstreet,

Serial No. 184,379,
Filed August 4, 1917, Div. 31—Room 169.

Apparatus and Process of Treating Hydrocarbon Oils.

61 Broadway, New York City,
November 17, 1919.

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

In response to Office action of November 19, 1919 please amend as follows:—

Specification, page 2, after line 16, insert—

B1 Fig. 4 is a diagram showing the connection of pipes as given in the other figures of the drawing.

Page 3, last line, change "The" to All the. Same line, change "tank" to tanks.

Page 4, line 1, change "is" to are. Lines 12 and 15, change "each" to all.

Page 5, line 21, after "lines" insert 54. Line 26, after "pyrometer" insert 53. Line 3 from bottom, cancel beginning "The vapor lines" to end of sentence.

Page 6, line 2, change "is" to are. Line 7, cancel "or distillate". Same line, after "run" insert from the tank 11a. Line 8, after "coils" insert 15. Line 11, after "conducted" insert through the vapor lines 15'. Line 12, after "tanks" insert into the header 48 and thence Line 15, after "series" insert of tanks 24-31. Line 16, after "a" insert condensed. Same line, change "to" to of. Same line,

4914 change "last" to preceding. Line 17, cancel "which" and substitute The last. Line 18, cancel "condenser coil 39" and substitute tank 11b. Line 19, after "conducted" insert through pipe 42. Line 20, after "tank" insert 11. Line 21, after "tank" insert 11. Same line, after "preheater" insert coils 10. Line 23, change "coil" to coils 2.

Page 7, line 4, cancel "through pipes of suitable size" and substitute as above explained. Cancel lines 5, 6 and 7.

Page 8, cancel lines 18, 19 and 20.

Claim 8, line 5, cancel "expansion".

Claim 13, line 4, cancel "expansion".

Claim 16, line 5, after "suitable" insert temperature and.

Claim 17, line 6, before "pressure" insert temperature and.

Cancel claims 7, 14 and 15, renumber the remaining claims and add the following:

D , ~~*(11)~~ †[~~16~~]: ~~The process treating hydrocarbon oil~~

Per F ~~which consists in subjecting said oil *(IN A CONDUIT) to temperature and pressure sufficient to vaporize said oil, condensing~~ *(FRACTIONS HEAVIER THAN) †[~~all but~~] ~~the benzine fraction and re-running the condensed portions of said oil through a~~ †[~~long~~] ~~continuous passage with steam and at sufficient temperature and pressure to crack said oil, and subjecting~~

" C ~~the~~ †[~~vaporized~~] ~~*(CRACKED) oil to continued~~

Per H ~~heat and pressure~~

~~F5~~ ~~in a long heat insulated passage~~

Insert C3 C3 ~~F5~~

Insert F6>

36

* Matter in parentheses inserted.
† Matter in brackets precanceled.

4915 REMARKS.

The drawings have been amended by placing suitable legends directly thereto as suggested by the Examiner, and also by showing the proper connection of the pipe 15. This pipe was not connected before because we thought that its connection would be plain, and for the reason that we desired not to complicate the drawings any more than necessary. The showing of a great number of pipes on the same level, as in a device of this kind, makes it quite confusing to trace up the various connections. We believe now that the same will be clear from the drawings, but in order to clarify the whole matter we are submitting a diagrammatic drawing, which is really a section through the furnace in part, and to which we have shown, in diagrammatic way, the digester tanks and the storage tanks.

From this new figure the flow of material will be apparent from the following explanation, which is already covered in the specification as applied to the other drawings.

37.

4916 The crude material is stored in tank 11a. It is conducted from this tank to the topping coils 15 and after being heated there, as explained in the specification, the vaporized material is carried over into the tanks 22, one of which is connected with each of said topping coils. Following this same material throughout its course, the vapor flows through the tanks 24-31 successively, certain parts of the material being condensed as it passes through, as explained in the specification. Finally the benzine fraction is taken off from the pipe 40 and collected in a suitable tank 11b. The heavier portions of this new condensed product are drawn off through the header 42 and conducted into the tank 11, from which tank the material is re-run starting in, however, from the tank 11, going first to the preheater coils 10 and from there to the cracking coils 4. In the cracking coils, the material is vaporized and goes over into the tanks 22 joining with the vapors coming from the topping coils, which coils are continuously supplied with crude oil from the tank 11a, as above explained. From this the Examiner will see that the topping coils have the function of separating the benzine fraction from the crude oil as it comes from the oil fields, and after this separation the heavier portions are then run through the

cracking units, first being preheated, and the portions which were not affected, except vaporized, when going through the topping coils, are cracked or transformed when run through the cracking coils, which as shown in the new figure presented herewith, are much greater in length than the topping coils for obvious reasons. This shows a complete cycle of operation, and after the apparatus is

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4917 once under way, the same remains continuous, the amount of crude and what we may call re-run portion to be cracked being controlled by the well known means of values. This operation is explained in a somewhat different way in the specification beginning page 6. The Examiner apparently, however, did not fully understand this operation on account of the incomplete details of the drawing. We believe that after the Examiner has been able to fully understand the intended operation (which he will now be able to do because the drawings are now complete in details), he will see that the apparatus and process are entirely operative, and will, therefore, withdraw his present rejection of the claims on the ground of inoperativeness.

There has been a misunderstanding on our part of the Examiner's position in his first action with respect to the question of operativeness. We did not take the Examiner's statement to be even an objection on the grouund of inoperativeness, because the Examiner merely stated that he was "disposed to question the operativeness of the apparatus", and from the succeeding statement we gathered that the Examiner did not as a matter of fact definitely raise the technical question of operativeness. While we undoubtedly should have mentioned that question in our amendment, it was not done because we did not understand the attitude of the Examiner to be one of a technical objection. After explaining in our amendment how the references did not apply and especially referring to our discussion on pages 5 and 6 as to claim 15 and claim 16, and after correcting the drawings as suggested by the Examiner, we thought we had fully answered whatever

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4918 criticism there might have been in the Examiner's mind on that ground. In fact the first statement of the Examiner as to inoperativeness related to the appara-

tus, and we presumed that when the drawings were corrected that objection, whatever it might be, would disappear. We did not understand the Examiner to question the operativeness of the process as a whole, assuming that the apparatus was there to carry out the process as described, which is in complete detail at the present time, and which we believe was there in substance before, but was undoubtedly open to some criticisms, which have been altogether overcome by our previous amendment and the present one.

In fact, there cannot be any question as to the operativeness of this process for two reasons; first, the process broadly considered is the same, as far as the cracking operation is concerned, (which is the only point the Examiner could possibly question) as contained in applicant's patent No. 1,110,924, under which applicant's assignee has been operating for a number of years, and by the use of which many thousand gallons of gasolene have been produced. The second reason is that by the use of an insulated passage for the vapors, it cannot be questioned that the heat is conserved and since it is conserved by this insulation there can be no reasonable doubt that a continued digestive action continues throughout the major part of the passage from the cracking coils to tank 31 by reason of the contained heat in the material under treatment. We have made no specific claim as to the exact percentage of increase by reason of this heat insulation as we could not accurately do because it varies with different fractions of oil, and since applicant starts out with crude oil and proceeds by first taking off the benzine frac-

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4919 tion by what might be called distillation and then proceeds to crack the same by the use of the fundamental process disclosed in his patent above mentioned and therefore, is dealing with and operating upon a substance having fractions subject to temperatures from the vaporization point of benzine to that of the heaviest ends of crude oil, we are unable to understand how the applicant could give, as the Examiner now requires, specific temperatures &c for named materials under treatment.

Applicant is not at present basing any claims upon specific temperatures or rates of flow or pressure but takes the position that invention exists in the conception of treat-

ing crude oil containing all of its natural fractions first by topping it (taking off the benzine fraction), mixing the vapors from the crude with vapors of re-run portions from the cracking coil, condensing those vapors in a series of heat insulated tanks under pressure, and continuously separating out the natural benzine fraction and that resulting from the cracking operation and continuously re-running the heavier end through the cracking coil with the conservation at all times of the heat employed.

The applicant does not contend that he discloses in this application any new process of cracking as such, but uses the process described in his patent above mentioned, and his contention is that he has made an improvement on that process, the same consisting in the steps above mentioned. The Examiner's requirement, therefore, that applicant give rates of flow, temperatures, dimensions, pressure, preferred manipulations for the gaining of a stated yield from named materials and his rejection of all claims for the lack of any such disclosure is believed to be entirely unwarranted. Applicant has disclosed to those skilled in the art his improvement in its entirety, and that is all

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4920 that the statutes require of an inventor in a specification.

Applicant clearly states in the opening paragraphs of page 2 that the objects of his invention are to reduce the cost of operation and especially fuel consumption, and increasing the percentage of light hydrocarbons recovered with a minimum amount of labor, and says that one way of accomplishing this result is by heat insulating the passages from the furnace to the exit, and certainly applicant has fulfilled all that is required of him in showing how his improvement is carried out.

As far as applicant's invention is concerned (and whether there is any invention or not seems to be the question at issue), it may be applied to any process of cracking or treating hydrocarbons, such as that shown in his patent above mentioned or any other where there is in fact disclosed a process which actually cracks a hydrocarbon fraction by a continuous process in vapor form, and we did not consider it necessary when the application was filed, to set out at length any or all of such processes, and fail to see even yet why such information is necessary to the understanding of the improvement which applicant has made

and which improvement he claims, and to which improvement all of his claims are limited. If the Examiner desires that some process and some kind of material be set forth in detail, applicant will be very glad to submit such data, but it seems to us that the whole matter might be easily covered by inserting in this application a statement that the conditions under which the cracking is carried on are those conditions set out in detail in applicant's patent No. 1,110,924. That patent having been published, is easily accessible and it would be, it seems to us, objection-

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4921 able from the point of view of the Patent Office for us to copy in this specification all of the details set out in that patent, but if the Examiner insists on the same we would be very glad to put all those details in the present application. We fail utterly to see wherein applicant's invention is made any more or any less clear, definite or complete whether the details as set forth in the patent above mentioned or the details of any other similar cracking process, if there by any such other system, is referred to or set out specifically in his specification or not, as it makes no difference whatever to this invention what the material acted upon is in the cracking stage, or the temperatures, or pressures used. The invention here described and claimed might be used with an infinite number of different kinds of material, temperatures, pressures &c.

The corrections to the specification have been made and the alternative matter referred to at the bottom of page 4 and the end of page 8 has been cancelled so that the specification is now without objection so far as we know.

The Examiner's understanding of the process as expressed in the last paragraph of page 2 is in the main correct as we have pointed out in detail in the preceding remarks, and the statement of operation on page 6 has been clarified so as to more fully set forth the whole process.

As to the Examiner's suggestion that more reference characters be added, we have followed that suggestion, but by reason of the additional figure which is presented herewith, we believe that all of the Examiner's criticisms along this line have been overcome and that the operation of the apparatus will be entirely clear from the diagram-

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4922 matic figure which we have presented with this amendment.

Only the material which is taken from the pipe 42 is rerun and not the material taken from the pipe 41 as stated in the letter. The route which the material from the pipe 42 takes has been added to the original drawings and further illustrated in the new sheet of drawings accompanying this amendment.

The large valve evidently referred to by the Examiner as occurring on Fig. 1 of the drawings is a test valve, that is to say, by slightly opening that valve and allowing the material to drip from the same it is easily determinable what the cracking action is.

The electric wires shown on Fig. 1 are connected with the ordinary pyrometer for showing the temperature.

It is believed that the function of the other valves is clear from their location, that is to say, they are the ordinary globe valves for controlling the flow of material through the pipe in which they are placed. Ordinarily there is no function for these valves except in the instance of one of the pipes becoming burned out or developing a defect of some kind when it would become necessary to shut off the flow through the pipe, and therefore valves are provided as in the ordinary way for such emergencies.

We do not agree with the Examiner that the last paragraph completed on page 7 is in any way indefinite, as it must be apparent that by the use of an excess of superheated steam a greater amount of temperature is given to the mixture, and by reason of that fact the increase in benzine fraction is produced. The topping coils being merely for the purpose of taking off the benzine frac-

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4923 tion, would naturally have a lower temperature than the cracking coils, and by reason of that fact an increase of the temperature would increase to some extent the amount of the benzine fraction taken off in those coils. By doing that with superheated steam the oil is prevented from being burned and in that way a higher temperature might be imparted to it. We, however, would not seriously object to eliminating that statement from the application if the Examiner insists upon it, but we believe that it is definite and is entirely proper.

The last paragraph but one on page 8 has been cancelled.

We cannot agree with the Examiner as to claim 6 calling for large and small passages. The material in going from one digester tank to another must necessarily go through the pipes 32, 33, 34 &c connecting the digester tanks. Since these are of much smaller diameter than the tanks themselves it follows that the material flowing is subjected to large and small passages successively. A benefit flowing from this arrangement is that the gases are more thoroughly mixed than they would be if it were not for the large and small passages. However, with regard to the Examiner's objection as to the expansion chambers, we believe that that is well founded because the gases are apparently not able to expand except a slight amount, due to the slight decrease in temperature which is inevitable.

Claims 14 and 15 have been cancelled.

We have sufficiently answered the Examiner's rejection as to the claims for the reasons set forth above, and we believe have also sufficiently answered him on the rejection of these claims on the references, having in our

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4924 amendment of August 14, 1918 gone into detail to point out why in our opinion none of the references shows the process set forth in the claims in this case.

We have now cancelled some of the claims because they were not in proper form; we fail to find in any of the references cited the employment of the invention of the claims in this case, and believe that it would be a loss of the Examiner's time to reiterate our remarks in our preceding amendment.

Perhaps too, when the Examiner has received more fully our views as to the meaning of the claims of the invention disclosed in the application, he may be disposed to modify his views with respect to the references. None of the references, as we have previously stated, shows a continuing pressure throughout a heat insulated passage, nor do they disclose processes which in any way could be properly considered as anticipations of the claims presented herewith, and we, therefore, consider it an answer to the Examiner's repeated rejection to call attention to the remarks made in our previous amendment together with the additional views expressed at the present time.

We appreciate the Examiner's suggestion as to applicant's filing a new case, but feel that our explanation will serve to clarify the Examiner's views on the question so

as to eliminate the necessity for that procedure, and we believe also that an issue has not yet been reached between applicant and the Office sufficiently for applicant to consider the Office letter as a final rejection. In any event, we would be very reluctant to consider an action final at least until a definite and clear issue had been reached between the parties, and we do not believe that

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4925 such an issue has yet been reached in this case.

We, therefore, respectfully request the Examiner to reconsider the whole case in view of the foregoing remarks and believe that upon doing so he will either allow the claims or at least eliminate many of the references and give us, if not an allowance, a rejection more specific than the rejections heretofore given, making it possible or easier for applicant to specifically meet the particular references cited against the specific claims. Such action is respectfully requested.

Respectfully submitted,
Kenyon & Kenyon,
Attorneys for Applicant.

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4926 UNITED STATES PATENT OFFICE.

(Stamp) Mail Room-Nov 18 1919 U. S. Patent Office.

In Re Application of Charles J. Greenstreet,

Serial No. 184,379, Div. 31—Room 169.
Filed August 4, 1917,

Apparatus and Process of Treating Hydrocarbon Oils.

61 Broadway, New York City
November 17, 1919.

Office Draftsman,
Washington, D. C.

Sir:

Will the Draftsman kindly make the changes in Figs. 1, 2 and 3 noted on the enclosed prints in red ink? Please also enter the accompany sheet of drawings as Fig. 4 in the application. Charge the same to our account.

Respectfully submitted,
Kenyon & Kenyon,
Attorneys for Applicant.

ok W.N.H.

48

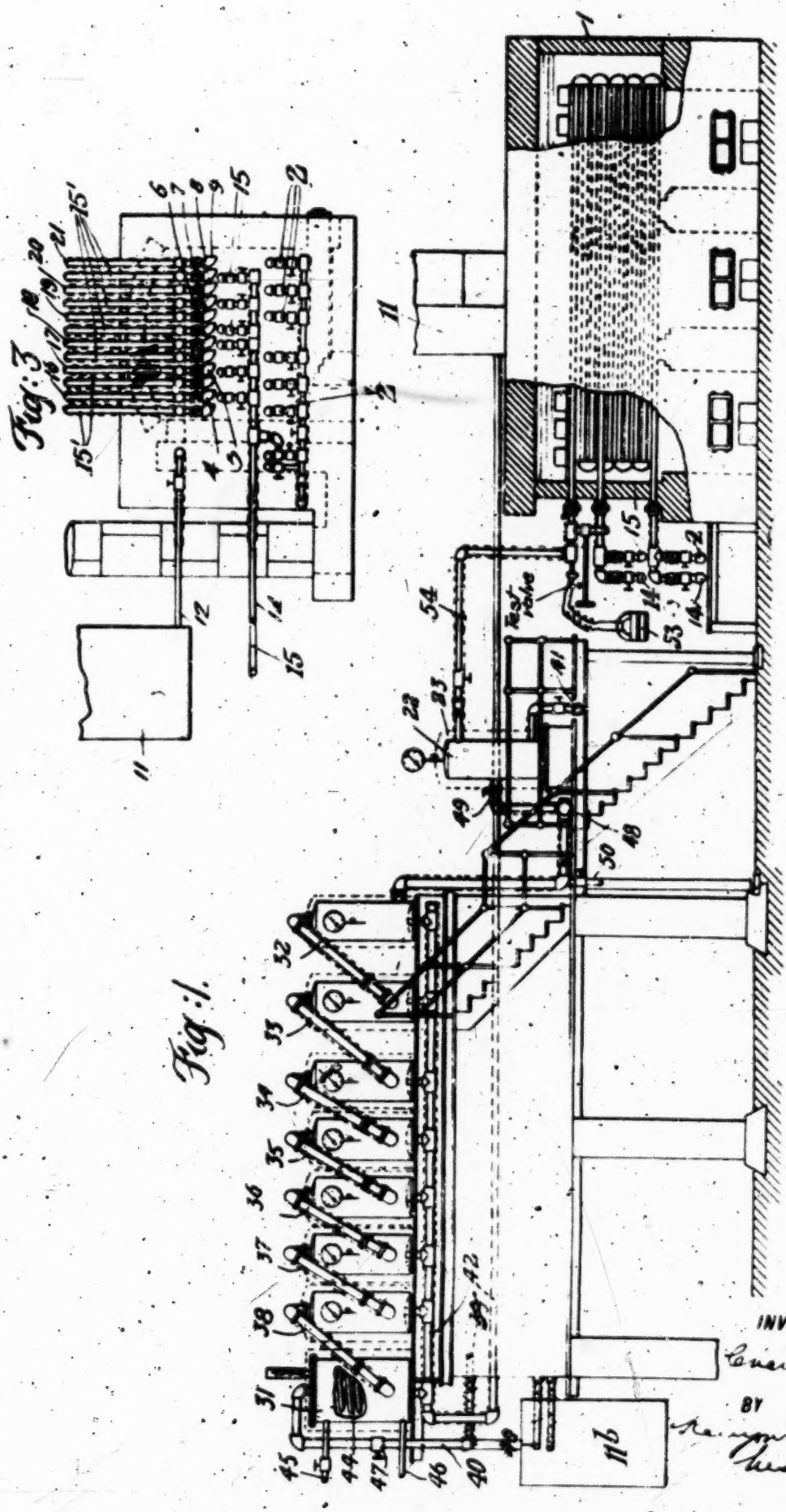
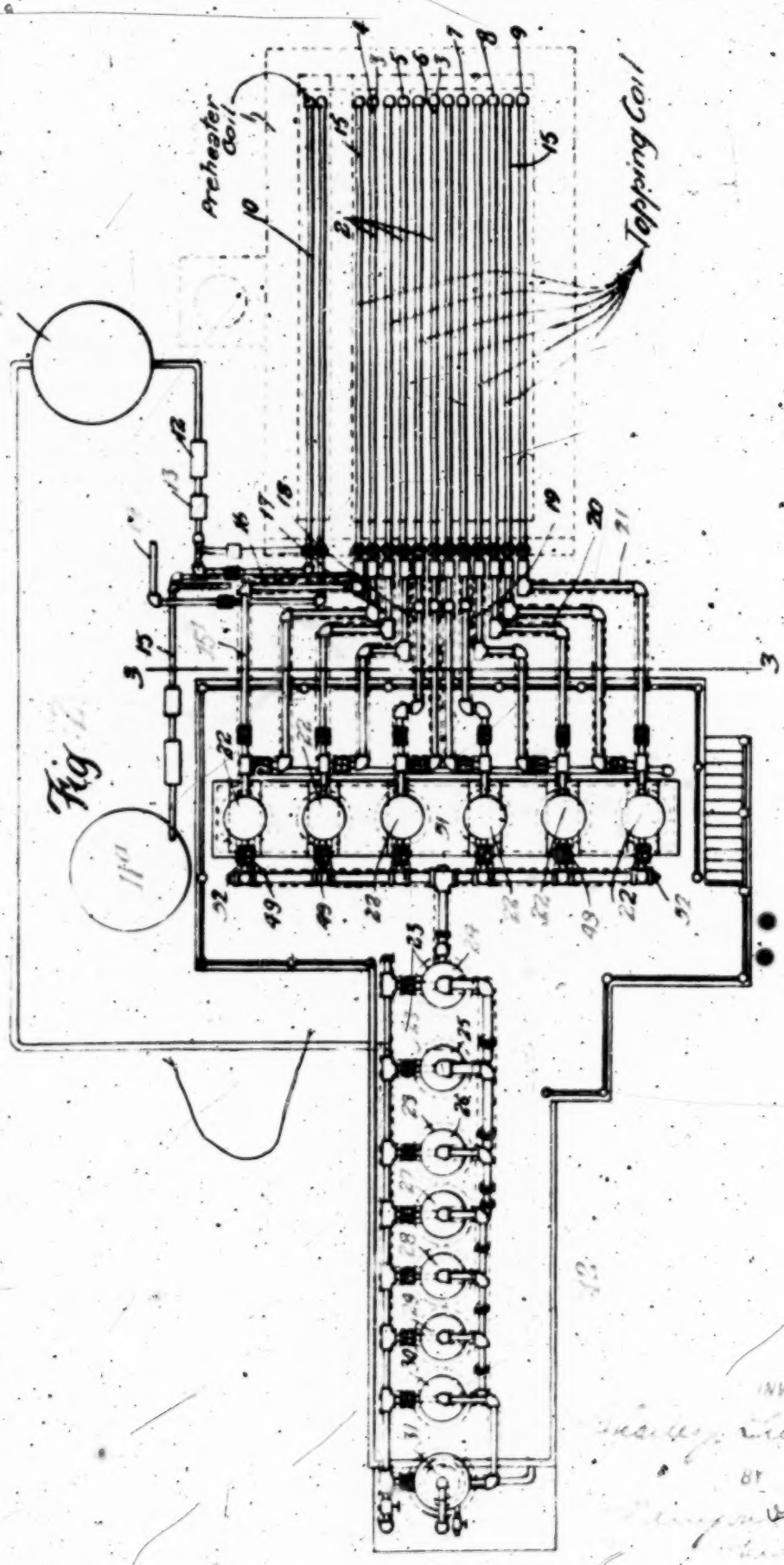


Fig: 3
Fig: 1.
INVENTOR
BY
ATTORNEYS


Preheater coil
Tapping Coil
Fig
INVENTOR
BY
ATTORNEYS

4981 In the United States Patent Office.

Paper No. 21 G.

(Stamps) Mail Room Nov 17 1925 U. S. Patent Office.

In re Application of
Charles J. Greenstreet
Apparatus and Process of
Treating Hydrocarbon Oils
Serial No. 184,379
Filed: Aug. 4, 1917

Div. 31
Room 314

103

4983 G' 2. The process of treating hydrocarbon oils which consists in
passing oil through coils to vaporize the oil, passing the oil
vapors into tanks containing hot cracked vapors, and passing the
resulting mixture through successive heat insulated tanks in which
the heavier portions are condensed and separated, passing the
Per H separated condensed portions through *the* coils under pressure and
raising said condensed oils to a cracking temperature, passing the
resulting cracked vapors into said tanks and mixing them therein
with said vaporized oils.

H' follows

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5007 Div. 31/MR

Address Only
The Commissioner of Patents
Washington, D. C.

Serial No. 184,379

DEPARTMENT OF COMMERCE

United States Patent Office

Washington

March 22, 1928

Charles J. Greenstreet, Assor

Your Application for a patent for an Improvement in Apparatus and process for treating hydrocarbon oils filed Aug. 4, 1917 has been examined and Allowed with 5 claims.

The final fee, Twenty Dollars, With $1 Additional for Each Claim Allowed in Excess of 20, must be paid not later than Six Months from the date of this present notice of allowance. If the final fee be not paid within that period, the patent will be withheld, but the application may be renewed within one year after the date of the original notice with a renewal fee of $20 and $1 additional for each claim in excess of 20.

The office delivers patents upon the day of their date, on which date their term begins to run. The preparation of the patent for final signing and sealing will require about four weeks, and such work will not be begun until after payment of the necessary final fee.

When the final fee is paid, there should also be sent, Distinctly and Plainly Written, the name of the Inventor, Title of the Invention, and Serial Number as Above Given, Date of Allowance (which is the date of this circular), Date of Filing, and, if assigned, the Names of the Assignees.

If it is desired to have the patent issue to an Assignee or Assignees, an assignment containing a Request to that effect, together with the Fee for recording the same, must be filed in this office on or before the date of payment of the final fee.

After issue of the patent, uncertified copies of the drawings and specifications may be purchased at the price of Ten Cents Each. The money should accompany the order. Postage stamps will not be received.

The final fee will Not be received from other than the applicant, his assignee or attorney, or a party in interest as shown by the records of the Patent Office.

Notice.—When the Number of Claims Allowed Is in Excess of 20, No Sum Less Than $20 Plus $1 Additional for Each Claim in Excess of Twenty Can Be Accepted as the Final Fee.

Respectfully,
Thomas E. Robertson,
Commissioner of Patents.

Chester H. Braselton
52 Vanderbilt Ave.,
New York, N. Y.

(In left-hand margin) ☞ In Remitting the Final Fee Give the Serial Number at the Head of This Notice.

(In right-hand margin) ☞ Uncertified checks Will Not Be Accepted.

129

5029 In the United States Patent Office.

Paper No. 36.

(Stamps) Application Div. Aug 10 1929 U. S. Patent Office. Issue Division Aug 10 1929 U. S. Patent Office.

In re application of
Charles J. Greenstreet,

Serial No. 184,379,
Filed August 4, 1917.

For—Apparatus and Process
of Treating Hydrocarbon Oils.

Hon. Commissioner of Patents,
Washington, D. C.

Sir:

AMENDMENT UNDER RULE NO. 78.

In the matter of the above entitled application, please cancel the proposed amendment filed July 31st, 1929, and substitute therefor the following amendment under the provisions of Rule 78, Rules of Practice:

*(6) ~~25.~~ The process of cracking hydrocarbon oils, which

* Matter in parentheses inserted.

comprises passing hydrocarbon oil through a heating zone and then
into a chamber containing hot cracked vapors, separating the
resulting vapor mixture from unvaporized residue, withdrawing
R. 78 unvaporized residue from the system and conducting the vapor
mixture into a vapor-separating zone in which the higher boiling
portions of the vapors are condensed and separated, passing the
resulting condensate through a second heating zone under pressure
and vaporizing and heating the same to a cracking temperature, and
passing the resulting cracked vapors into said chamber wherein
they are mixed with the constituents of said hydrocarbon oil.

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5030 *(7) ~~26~~. The process of cracking hydrocarbon oils in the vapor
phase which comprises bringing preheated topped crude oil into
intimate contact with hot oil vapors resulting from the vapor
phase cracking of a hydrocarbon oil, separating vapors from
unvaporized residue oil, withdrawing said residue and passing the
resulting separated vapor mixture into a vapor-separating and
condensing zone in which the heavier portions of said vapors are
condensed and separated, passing said separated condensate into
a vapor phase cracking zone in which the condensate is vaporized
and cracked by heat in vapor phase to produce at least in part
said hot oil vapors, and passing the resulting hot cracked vapors
into contact with said preheated topped crude oil.

* Matter in parentheses inserted.

*(8) ~~27~~. The process of cracking hydrocarbon oils, which
R. 78[1] comprises preheating hydrocarbon oil in one zone
Contd and conducting
the same into a chamber in ~~contact~~ with hot ~~cracked vapors~~,
separating the resulting vapor mixture from unvaporized oil in
said chamber, withdrawing the unvaporized oil from said chamber
and conducting the separated vapor mixture into a vapor condens-
ing zone in which the higher boiling portions of the vapors are
condensed and separated, vaporizing resulting condensate and
heating the vapors to a cracking temperature in a second zone
maintained at a temperature adapted to crack the condensate
vapors, and passing the resulting cracking vapors, while at a high
temperature into said chamber wherein they are contacted with
said preheated hydrocarbon oil.

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5031 *(9) ~~28~~. The combined process of topping crude petroleum and
cracking a distillate thereof, which comprises heating crude
petroleum to a temperature sufficient to vaporize portions of its
lower boiling constituents, thereafter mixing the vaporized and
unvaporized constituents of the crude petroleum with hot cracked
oil vapors in a contact zone, separating the resulting vapor
R. 78[1] mixture from residue oil in said contact zone, con-
Contd ducting the
separated vapor mixture into a vapor condensing zone in which

* Matter in parentheses inserted.

portions of the higher boiling point constituents are condensed
and separated, separately heating and cracking the condensate
from said condensing zone to produce said hot cracked oil vapors,
and mixing them with the heated constituents of said crude petroleum.

(Sig.)

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5032 REMARKS.

The above application having been allowed, it is respectfully requested that the above amendment be entered under the provisions of Rule 78, Rules of Practice.

The claims presented in this present amendment are closely related and drawn to cover subject matter similar to that contained in allowed claims and other claims previously presented in the application. By comparing allowed claim 17, for example, it will be noted that this claim covers the process for cracking hydrocarbon oils in which the oil to be treated is heated to vaporize portions thereof, after which it is introduced with the vapors into tanks containing other hot cracked vapors. The claim further specifies that the resulting vapor mixture is conducted into a series of heat insulated tanks where the heavier portions of the vapors are condensed, and thereafter passing the condensate through heating coils in which it is cracked, the resulting cracked vapors being conducted to the first mentioned tanks and mixed with the vapors produced from the oil. This claim 17 has been inadvertently limited to the use of a plurality of tanks and coils in the various steps of the process, which limitations are entirely unnecessary, either from the standpoint of the process or the cited art.

The applicant therefore has presented four new claims which have been drawn to cover substantially the same process steps as those referred to above in connection with claim 17. These claims, however, are not limited to the

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5033 use of a parallel arrangement of apparatus elements. Claim 25 has been drawn to parallel the process

steps of allowed claim 17 without, as previously stated, including apparatus limitations. The claim also contains the additional limitation that the unvaporized residue remaining after mixing the cracked vapors with the preheated oil be withdrawn from the system. This claim is therefore clearly allowable.

Claim 26 covers, in slightly different phraseology, substantially the same process as that covered by claim 25, and is further limited to the treatment of topped crude oil.

Claim 27 is also drawn to cover substantially the same process steps as claim 25, but is slightly different in scope in respect to the preheating and separation of vapors from unvaporized residue. Claims 26 and 27 are believed to be clearly allowable.

Claim 28 has been limited to the combined topping of crude oil and cracking a distillate thereof. This claim covers specifically the applicant's process as outlined beginning with the third paragraph, page 6, of the specification. This claim is considered to be more limited than the other claims in regard to the oil being treated and the cracking a distillate produced from the oil by the combined process resulting from the mixture of hot cracked vapors with the constituents of heated crude petroleum.

In presenting the above claims it is respectfully submitted that the holding in the Office action dated July 16, 1929 does not apply. It further appears that the Honorable Assistant Commissioner in approving this Office action did so under the impression that the applicant had a remedy by filing a renewal or divisional application. But, as later explained to the Honorable Assistant

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5034 Commissioner, neither of these courses of action were open to the applicant because more than one year had elapsed since the application was first allowed. In view of these circumstances and the fact that the claims already allowed are inadequate to protect the applicant's invention, it is respectfully submitted that the above amendment should be approved and entered.

The claims as presented in the above amendment have been drafted after a very careful review and consideration of the prior art references which have any bearing on the subject under consideration. The reference considered included the following patents: Lang, 954,575, patented

April 12, 1910, and Rittman et al. 1,365,604, patented January 11, 1921 (filed February 5, 1917).

The patent to Lang discloses an apparatus for distilling hydrocarbon oils with the object of completely cracking the oil to produce a very light distillate product. Referring to Figure 1 of the drawings, the crude oil to be treated is introduced into the system by means of a pipe 6, vaporized in the heater 5, and conducted by means of a pipe 7 into a vapor cracking tube 8. The tube 8 is mounted in the furnace 1 so that the vapors will be heated to a very high cracking temperature approaching approximately that used for converting oil into combustible gas. The vapors from the cracking tube are conducted through a vapor line 13 to a series of condensers 15, 16 etc. from which the heavy condensate is conducted, vaporized and reintroduced into the cracking tube 8. Lang discloses a modified procedure outlined on page 3, beginning with line 92, by which crude oil is completely vaporized in the heater 5 and conducted through a pipe 44 directly to the condensers 15, 16 etc. The condensed product, which in this case would also include the residue, is then returned and passed to the heating tube 8.

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5035 Aside from the fact that Lang discloses essentially an apparatus designed to completely crack crude oil, his disclosure does not anticipate the process claims presented in this amendment. For example, Lang does not show the step of mixing cracked vapor products with other oil and vapors in one zone, the separation of the unvaporized residue and the cracking in a separate zone of a relatively clean distillate free of heavy constituents which would coke up the cracking tube. These combined features constitute the essential basis of the applicant's invention, as more particularly pointed out in the claims. The patent to Lang therefore is not an anticipation for the above claims, and in fact has little bearing on the subject matter of the same.

The patent to Rittman which is based on an application copending with the applicant's case, discloses a process for cracking heavy hydrocarbon oils in the vapor state in retorts of relatively large diameter. Referring to the figures of the drawings, the raw oil to be treated is introduced into a cooler 5, after being preheated in a jacket 4. The mixture of heavy oil and condensate from the chamber 5

is then conducted to the cracking retorts 10 where the oil is alleged to be vaporized and cracked in the vapor state. The vapors produced in the retorts 10 are then conducted into the chamber 5 to contact the oil introduced thereinto.

In distinction from the disclosure of Rittman, the applicant's claims are drawn to the process in which the vapor mixture, after being brought in contact with preheated oil, is separated from the oil residue which is withdrawn from the system and thereafter conducted to a vapor fractionating zone. In this zone a clean distillate is produced which

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5036 exclusively used in the vapor phase cracking operation. Rittman's disclosure provides for no such procedure, indicating that he did not recognize the value and importance of providing a relatively clean distillate to be cracked in the vapor phase. Rittman, instead of withdrawing residue from the system, as specified in claims 25, 26 and 27, actually conducts the residue into the cracking retorts. In regard to claim 28 which is limited to the combined topping of crude petroleum and the cracking of a distillate thereof, it is plainly evident that the disclosure of Rittman has substantially no bearing on this claim. The claims presented in this amendment are therefore clearly allowable over the Rittman patent.

From the above discussion and the facts presented in connection with this application, it is readily apparent that the above presented claims are necessary to adequately protect the applicant's invention and that the claims are clearly allowable over the prior art, the more important references of which have been considered.

Favorable consideration and entry of the amendment proposed above is respectfully requested.

Respectfully submitted,

Edmund G. Borden,

Attorney for Applicant.

Entry Recommended Under Rule 78.

W. S. Holmes,

Examiner.

Div. 31

Entry Approved:

Wm. A. Kinnan,

Acting Commissioner of Patents.

H.S.

August 9, 1929.

158

5037 261-a

Div. 31 Room 312 Paper No. 37

Address only "The Commissioner of Patents, Washington, D. C.," and not any official by name.

All communications respecting this application should give the serial number, date of filing, and name of the applicant.

DEPARTMENT OF COMMERCE

United States Patent Office

Washington

July 10, 1920.

Applicant: Chas. J. Greenstreet

Ser. No. 184379
Filed August 4, 1917

For Treating Hydrocarbon Oils

Edmund G. Borden
60 Wall Street
New York, N. Y.

The amendment proposed has been entered under Rule 78.

Thomas E. Robertson,
Commissioner of Patents.

159

DX 811

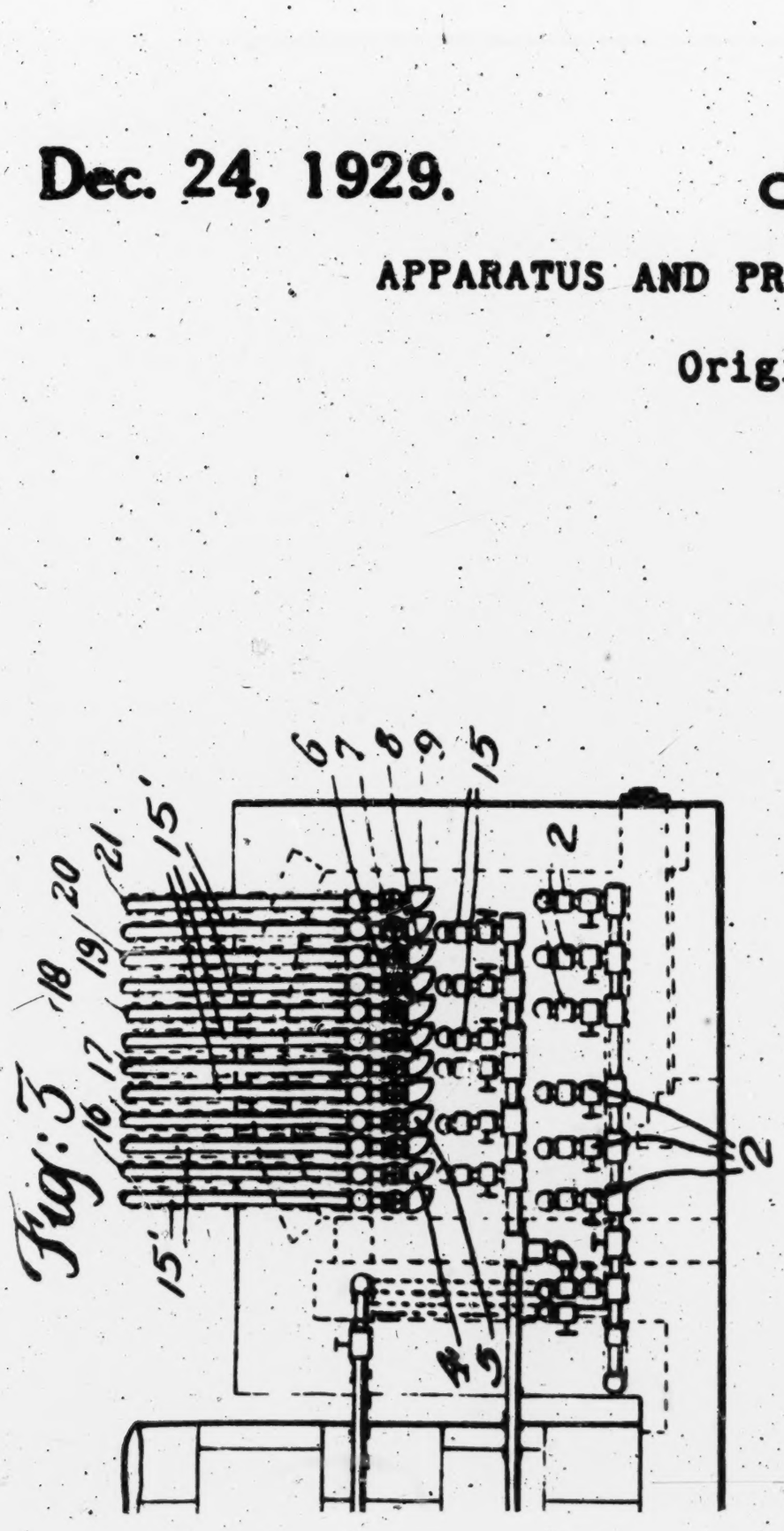
Dec. 24, 1929. C. J. GREENSTREET 1,740,691

2953

APPARATUS AND PROCESS OF TREATING HYDROCARBON OILS

Original Filed Aug. 4, 1917 3 Sheets-Sheet 1

Fig: 3



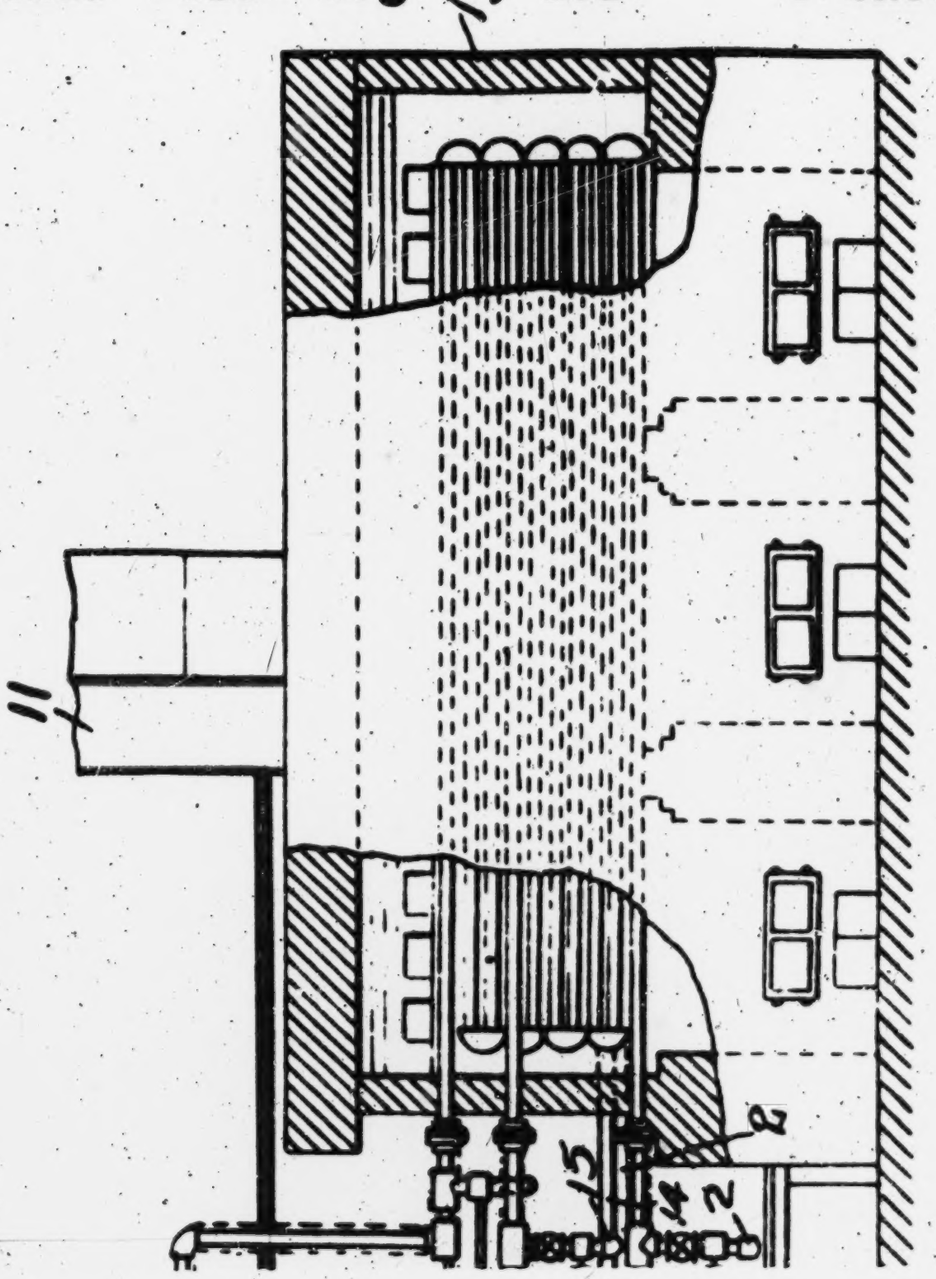
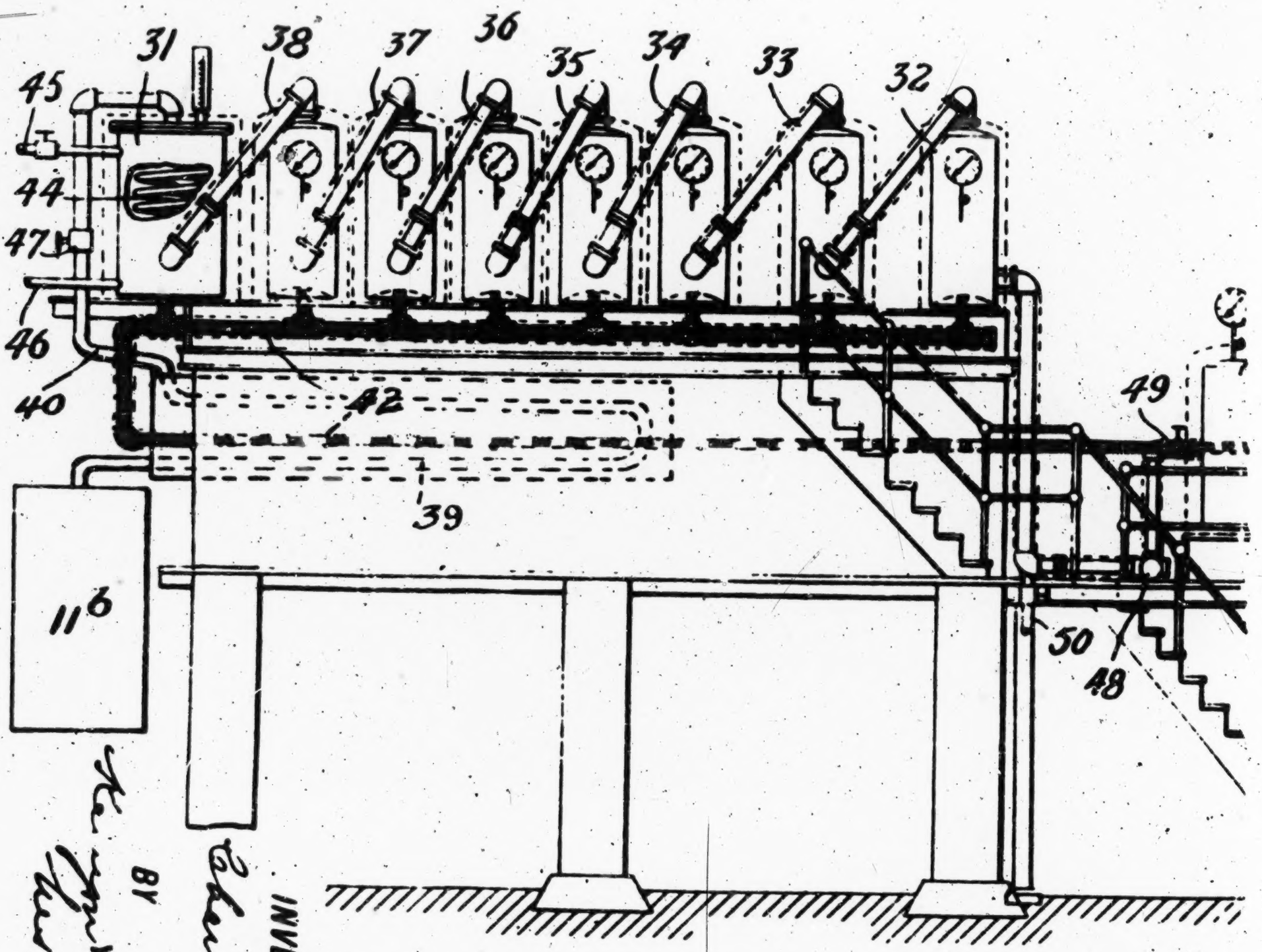


Fig :1.



INVENTOR
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ATTORNEYS

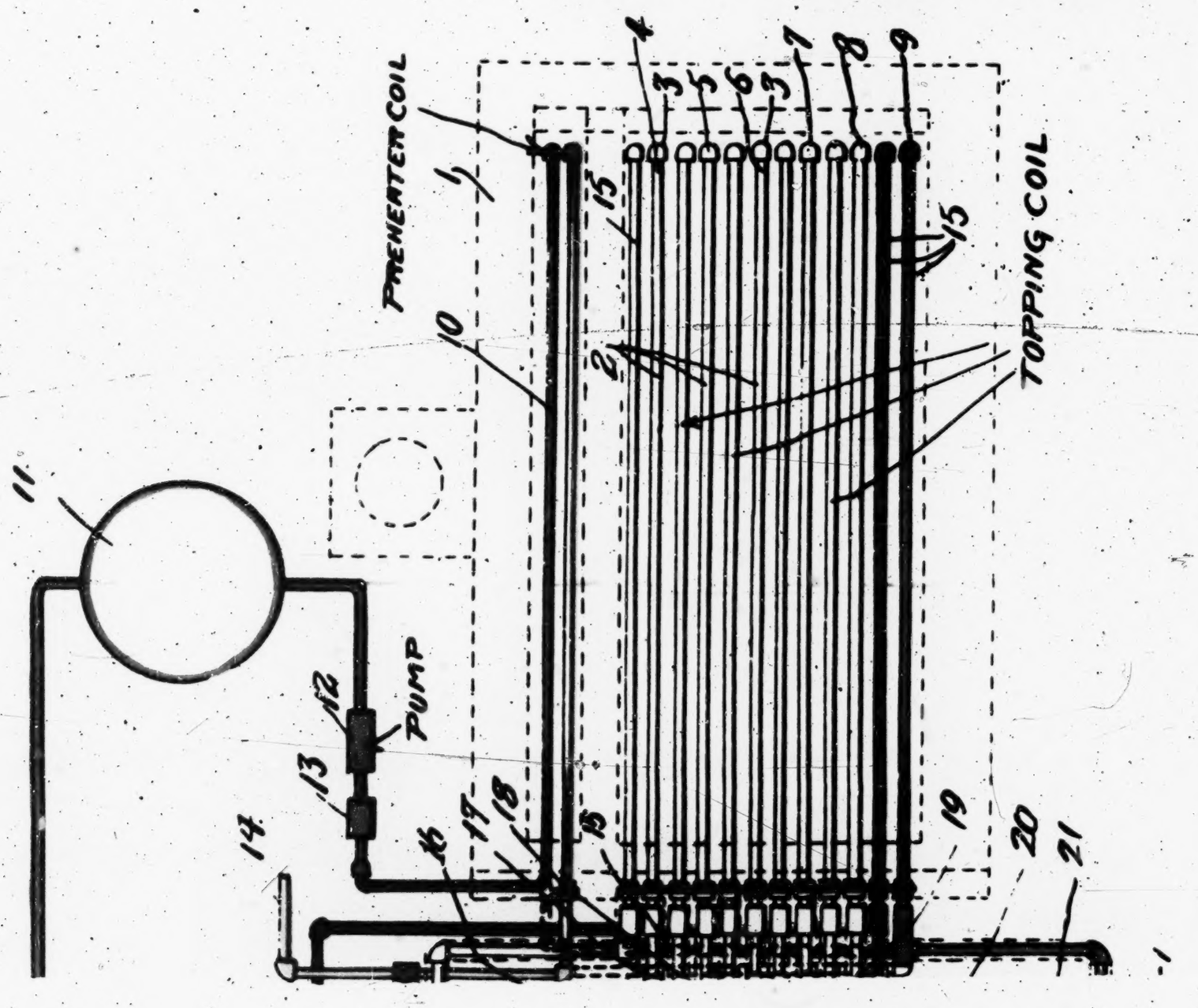
DX 811

Dec. 24, 1929. C. J. GREENSTREET 1,740,691

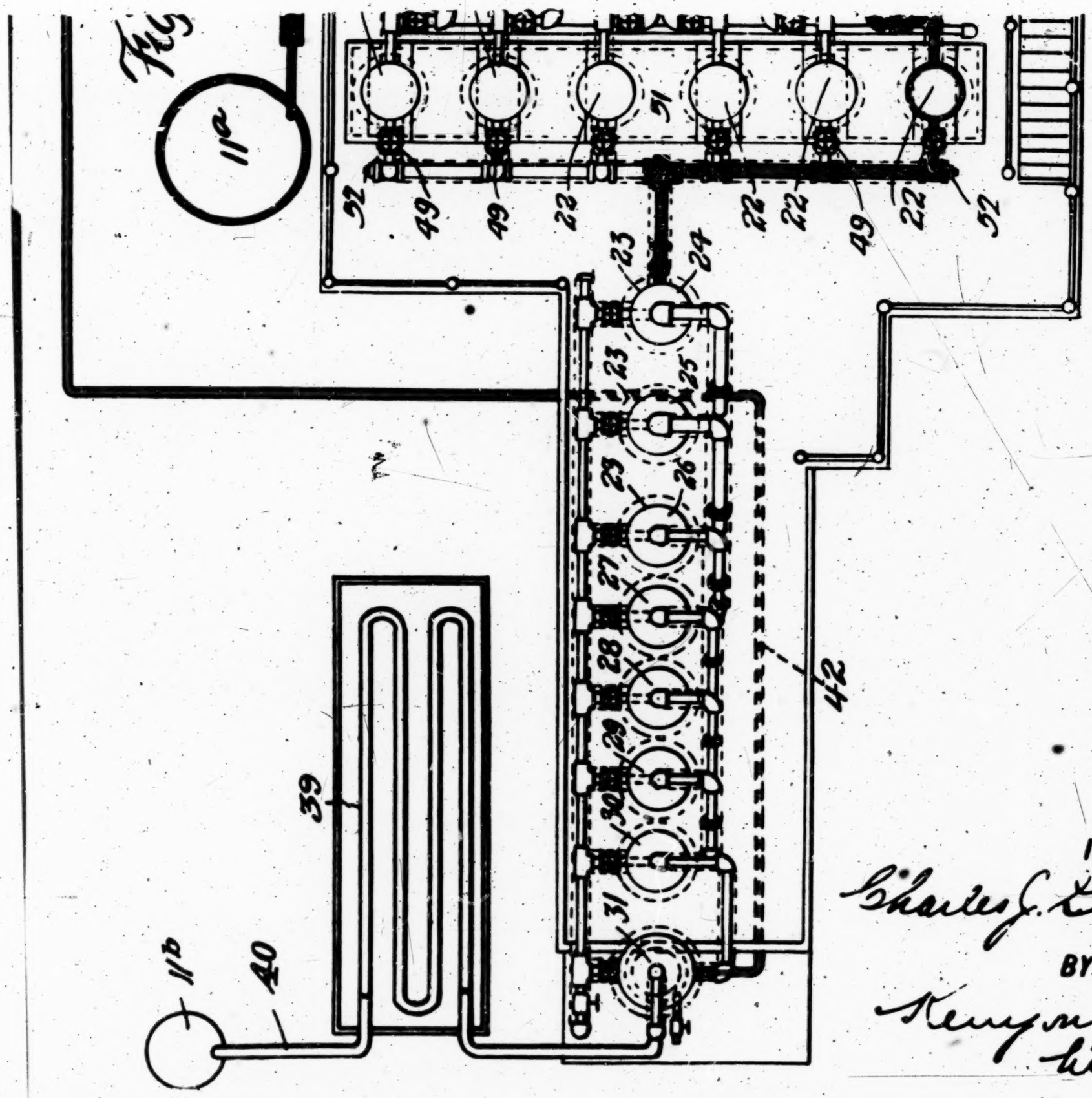
2955

APPARATUS AND PROCESS OF TREATING HYDROCARBON OILS

Original Filed Aug. 4, 1917 3 Sheets-Sheet 2



IN THE UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION
UNIVERSAL OIL PRODUCTS CO. } No. 10744
VS.
GLOBE OIL & REFINING CO.
DEFENDANT'S EXHIBIT 811



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DX 811

Dec. 24, 1929. C. J. GREENSTREET 1,740,691

2957

APPARATUS AND PROCESS OF TREATING HYDROCARBON OILS

Original Filed Aug. 4, 1917 3 Sheets-Sheet 3

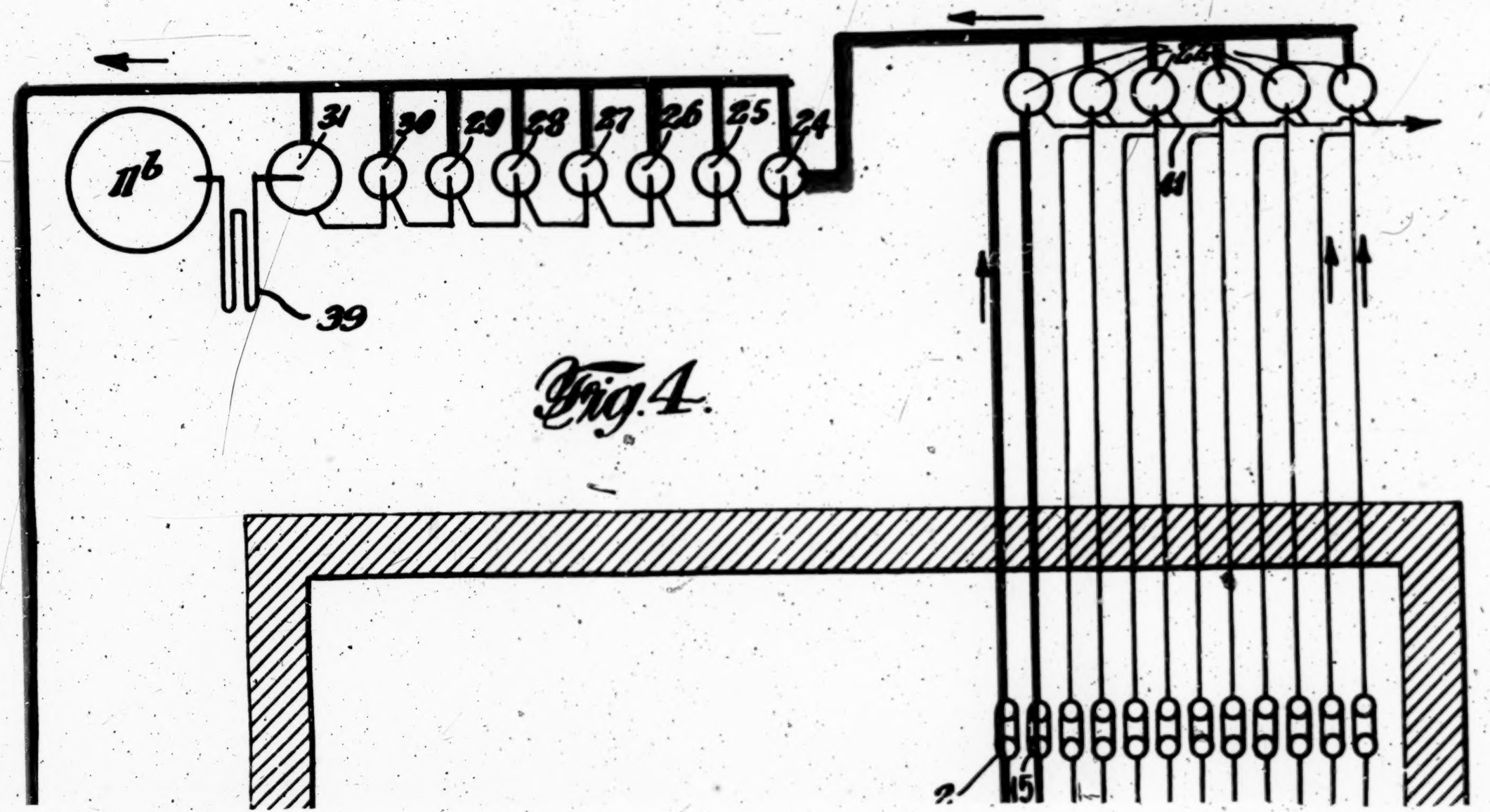
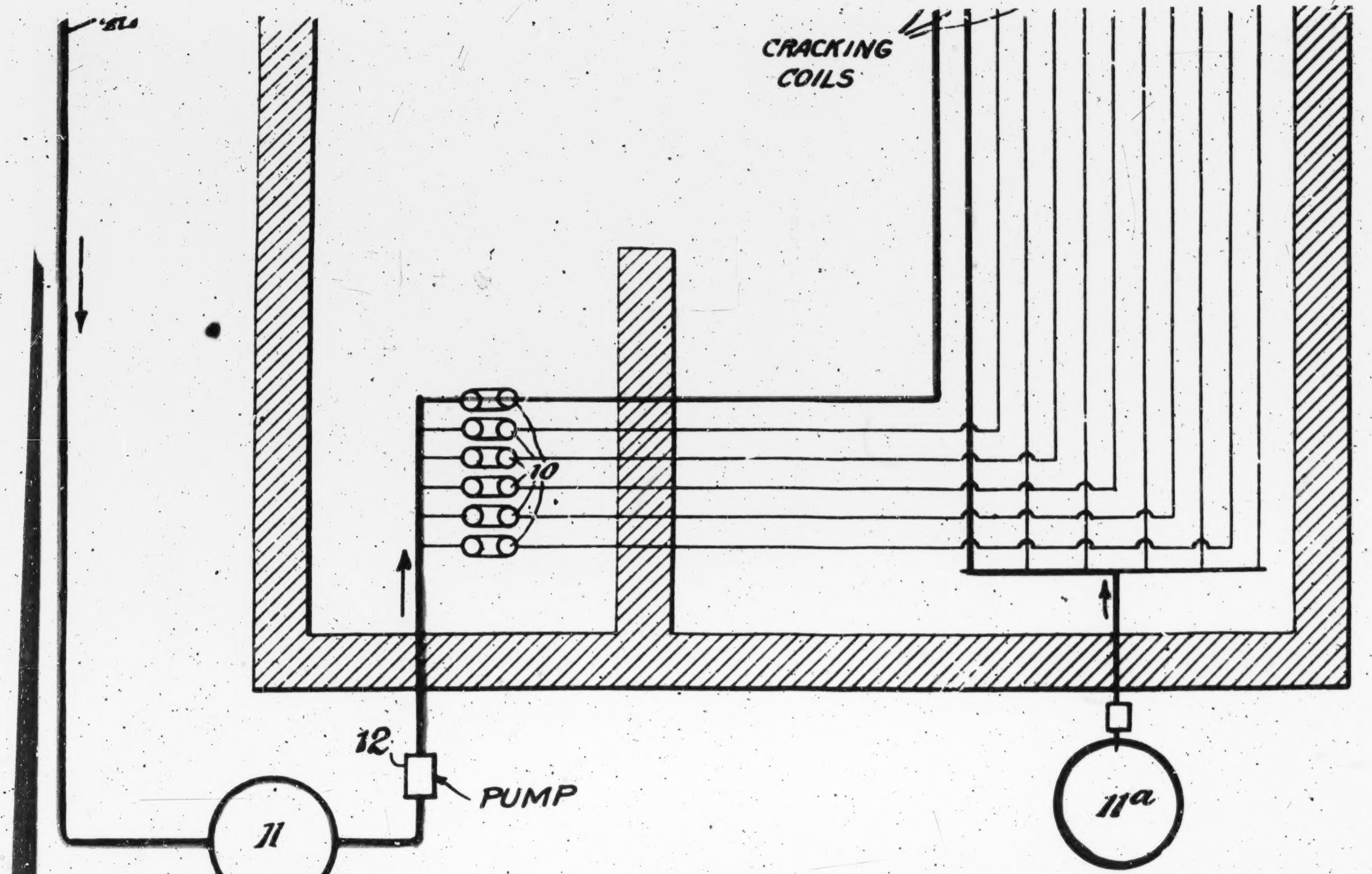


Fig. 4.



Inventor
Charles J. Greenstreet

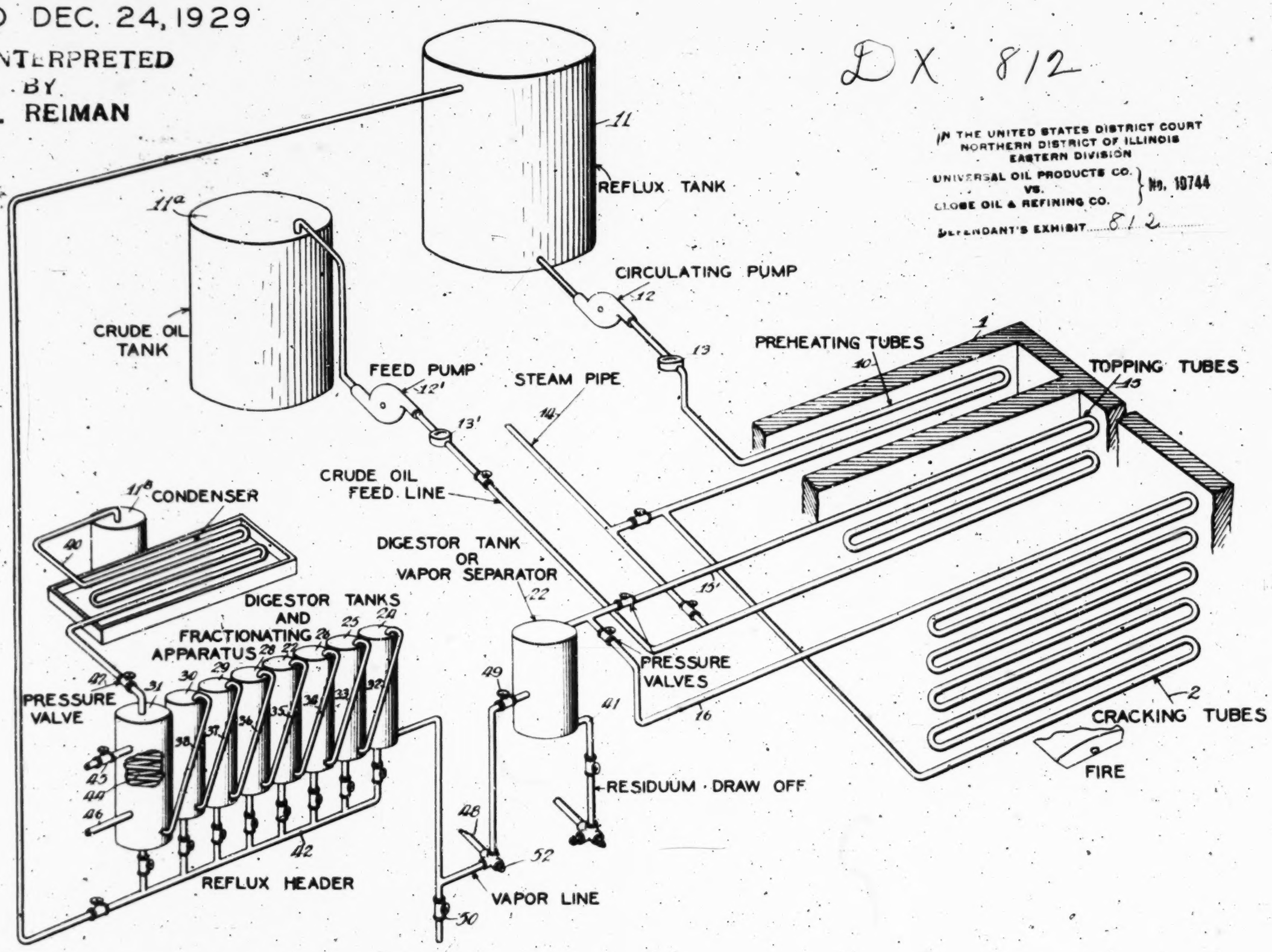
By his Attorneys
Kenyon & Kenyon

GREENSTREET PAT. NO. 1,740,691
FILED AUG. 4, 1917
ISSUED DEC. 24, 1929
AS INTERPRETED
BY
DR. REIMAN

2959

DX 812

IN THE UNITED STATES DISTRICT COURT
NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION
UNIVERSAL OIL PRODUCTS CO.
VS.
CLOSE OIL & REFINING CO. } No. 19744
DEFENDANT'S EXHIBIT 812



5064 DX 816.

[This exhibit was offered and is included in the appeal record under the provisions of Rule 43(c).]

5065 DX 816 ID.

DEPARTMENT OF COMMERCE

United States Patent Office

To all persons to whom these presents shall come, Greeting:

This Is to Cerify that the annexed is a true copy from the records of this office of the File Wrapper, Contents and Drawings, in the matter of the

Abandoned Application of
Carbon P. Dubbs,

Filed December 21, 1917, Serial Number 208,206,
for

Improvement in Method and Apparatus for Treating Hydrocarbon Oils.

In Testimony Whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed, at the City of Washington, this seventh day of June in the year of our Lord, one thousand nine hundred and twenty-nine and of the Independence of the United States of America the one hundred and fifty-third.

Thomas E. Robertson,
(Seal) *Commissioner of Patents.*

Attest:
D. E. Wilson,
Chief of Division.

5068 PETITION.

(Stamp) Mail Room Dec 21 1917 U. S. Patent Office.

Honorable Commissioner of Patents:

Your petitioner, Carbon P. Dubbs, a citizen of the United States, residing in the City of Wilmette, County of Cook, and State of Illinois, whose postoffice address is 905 Greenleaf Avenue, Wilmette, Illinois, prays that Letters Patent of the United States may be granted to him for new and useful Improvements in Method and Apparatus for Treating Hydrocarbon Oils described and claimed in the annexed specifications.

Signed at Chicago, Illinois, this nineteenth day of December, 1917.

Carbon P. Dubbs.

5069 SPECIFICATION.

To All Whom It May Concern:

Be It Known That I, Carbon P. Dubbs, a citizen of the United States, now residing in the City of Wilmette, County of Cook, and State of Illinois, have invented certain new and useful improvements in

per C Method ~~and Apparatus~~ For Treating Hydrocarbon Oils.

of which the following is a specification.

per. D The invention relates to a method ~~and apparatus~~ for treating hydrocarbon oils to produce therefrom products having lower boiling points.

My invention contemplates, among other things, a method and apparatus whereby crude petroleum, petroleum distillates, petroleum residuum, or mixtures thereof is

passed through the apparatus and more or less converted to
lower boiling point products; other objects of my invention
are; to provide a means for heating oils in coils while main-
taining the oil under definitely controlled velocity and tem-
peratures, then passing the heated oil to an up-
right tank
and from there into a settling tank and then back through
the same heating coils; to provide a process for contin-
uously treating petroleum for production of lower boiling
point products; to provide a means for automat-
ically con-
densing the heavy vapors and returning same for further
treatment; to provide a means whereby either water, in the
shape of water or steam or both can be injected into the oil
while under going treatment; to provide a means whereby any
water condensed in the reflux condenser is auto-
matically
trapped and either automatically returned to the heating
coils or withdrawn from the system; to provide a means for
holding a higher pressure upon the oil while same is cir-
5070 culated through the heating tubes and holding a lower pressure
on the upright and settling tanks and reflux con-
denser;
to provide a means for rapid circulation of oil in heat-
ing coils and relatively slow circulation in the settling
tank; to provide a means for passing the heated oil up

through a body of oil, to provide a means of continuously
feeding raw material and continuously taking off lower
boiling point products and also for continuously taking off
the residuum containing more or less free carbon; to provide
a means to prevent the free carbon or other solids from
settling on the walls of the heating tubes; to provide a
means whereby the forced circulation in a continuous coil
creates a pressure on the oil in excess of that maintained
on the rest of the apparatus whereby the oil in said coil
can be subjected to a higher heat without being converted,
to any great amount, into vapors, and said oil is passed in-
to a chamber of lower pressure, the boiling point of said
heated oil is thereby lowered and more or less of same thus
converted into vapors; to provide a means whereby the oil
while being heated is maintained at a relatively high vel-
ocity and then passed in a much larger stream through a
settling tank and owing to this stream being much larger
its velocity has been greatly reduced which will cause the
excess carbon held in the oil to be precipitated out; to provide a means whereby the length of time the oil being
treated is subjected to heat during any one time is under
full control; to provide a means whereby the amount of
heavy vapors condensed and returned for farther treatment

is controlled; to provide a means whereby any partial ob-
struction in the heating tubes automatically thereby in-
creases the velocity of the oil at said point of partial
5071 obstruction which will act to remove such obstruction; to
provide a means for maintaining the interior surface of the
tubes in a smooth highly polished condition by means of pass-
ing the oil through same at a high velocity; to provide a
means for frequently relieving the oil in the heating tubes
of its vapor contents; to provide a means for bringing part of
the residuum to a quiescent state and allowing the free
carbon or other solids to settle and withdrawing same and
returning the settled residuum back into the circulation
for farther treatment; to provide, in general, a process
and apparatus of the character referred to.

In the drawings, fig 1 is a side elevation of the apparatus, partly in section and partly broken away. Fig. 2 is a plan view of the apparatus, with part in section.

Referring to the drawings: A is the furnace in which the heating tubes B. are positioned. A-2 is a flue tunnel connecting said furnace to stack marked A-3. B-1 are return connections on the ends of the tubes B. and on these return connections, positioned on the end of each tube are flanges which may be readily removed and the interior of each of the tubes be examined and cleaned.

C, C-1, C-2, C-3, are check valves positioned on the
different lines.

D, and D-1 are pressure regulating valves.

E-1 to E-14 inclusive and E-17, E-18 and E-19 are throttle valves.

F, F-1, F-2, F-3, F-4 and F-5 are pyrometers.

G, G-1, to G-6 inclusive are pressure gauges.

H, H-1, H-2, H-3, H-4 are glass liquid gauges.

J, J-1 are steam pumps; K is the discharge line from the heating coil B. to the tank K-1. K-2 is the
5072 overflow from tank K-1 to tank K-3, and connected with K-2
is line K-4 to tank K-5 having positioned on it valve E-5.

K-6 is suction line connecting pump J-1 to tank K-3 and connecting with suction line K-6 is suction line K-7 connecting
it with tank K-5 and on these two suction lines are positioned
valves E-6 and E-7.

L is discharge line from pump J-1 to the heating tubes B
and L-1 is the discharge line from pump J to tank K-1.

M is the suction line to pump J. N. is the draw-off from
per A the bottom of tank K-3*(,) ~~and~~ a similar one being positioned on
the bottom of tank K-5.

P are the vapor lines from tanks K-1, K-3 and K-5 leading
to a reflux air condenser Q.

Q-1 is a header on the lower end of the air condenser and
Q-2 is a header on the upper end of this condenser which are
connected by the slanting tubes Q-3, and out of the header Q-2
extends vapor line P-1 connecting with condensing coils R

* Matter in parentheses inserted.

positioned in the water cooling tank R-1 and extending into the
top of tank S. and extending out of the top of tank S is gas
line S-1. Q-4 and Q-5 are doors in the housing surrounding
the tubes Q-3 of the reflux air condenser Q, these doors being
for the purpose of controlling the amount of air circulated
around the tubes Q-3.

T is a line extending from the end of the header Q-1 into
the tank K-3 with branch T-1 extending to tank K-5.

W is a line extending from the bottom of the header Q-1
into the bottom of the suction line K-6 or can be drained into
the tank X. X-1, X-2 and X-3 are supports for the different
parts of the apparatus.

Y is a line entering the discharge pipe L through which
steam or water or both are injected from any suitable
5073 source of supply. Y-1 being another line for a similar
purpose. Z and Z-1 are steam lines to pumps J and J-1.

Now describing the operation of the process, the mater-
ial to be treated is drawn from any suitable source of sup-
ply through line M, through pump J, through line L-1 into the
different parts of the apparatus until the proper amount of
the material to be treated has been charged into the said
apparatus, which amount should be sufficient to fill the
per A heating tubes B, and tank K-1 to overflow *(IN-
TO) tank*(S) K-*(3)2 and ~~tank~~

* Matter in parentheses inserted.

" A K-*(5)~~5~~ to overflow suction line K-6 so that suction line K-6
will always be covered while pump J-1 is in operation. Pump
J is then shut down for the time being and pump J-1 is put
into operation and by this means the oil is circulated through
discharge line L into and through the heating tubes B then
through line K into and through tank K-1 to overflow K-2 into
and through tank K-3 and then to overflow suction K-6 into and
through pump J-1 and so on as above described. Fire is
placed in the furnace A and maintained at a proper temperature,
which temperature will range from 400 to 2400 F. The *(SPECIFIC) ~~pacific~~
temperature that will be used in any one case will depend on
many things, such as the volume of oil treated in any given
period of time also on the velocity at which the oil is passed
through the heating tubes B also on the character of material
being treated.

As the oil passes through the heating tubes B it is subjected to the proper heating and then is passed up through the
oil contained in the tank K-1 and the vapors liberated in this
tank pass out through the vapor lines P while the oil overflows from tank K-1 through overflow pipe K-2 into tank K-3
and the vapors liberated while the oil is passing through
5074 tank K-3 pass up through the vapor line P into the header

* Matter in parentheses inserted.

Q-1 through air cooled tubes Q-3 and into header Q-2 and
per A from there through pressure valve *(D-1) through condensing coils
R into receiving tank S from which the distillate is drawn
either continuously or intermittently through valve E-9, while
the uncondensible gas is drawn off through line S-1. K-5 is
a tank similar in detail to tank K-3, and is so connected with
the apparatus by means of overflow pipe K-4 and overflow suction pipe K-7 and vapor lines P, that either or both of
these tanks can be used or either be cut out and cleaned
while the other is in use and the apparatus maintained in
operation. For instance tank K-3 can be cut out of the
apparatus by the closing of the valves E-2, E-7, E-3 and E-19
which will cut out the tank K-3 and by opening valves E-5,
E-4, E-6 and E-17 will put in commission the tank K-5 and the
tank K-3 can then be cleaned; and reversing the opening and
shutting of the above mentioned valves will put tank K-3 back
in operation and cut out tank K-5. The vapors condensed in
the header Q-2 and the connecting pipes Q-3 and header Q-1 will
flow into the header Q-1 and then be drained back into tank
K-3 or tank K-5 according to which is in operation, and any
water condensed along with this distillate will be collected

* Matter in parentheses inserted.

in header Q-1 and can be drawn off through line W into tank X
by the closing of valve E-10 and the opening of valve E-11 or
it may be returned to the apparatus into the bottom of suction
line K-6 by opening valve E-10 and closing E-11, or the distillate collected in Q-1 may be handled in the same way. As
the oil passes through tank K-3 or tank k-5 and while the volume
passing through this tank in any given space of time, is as great as
the oil passed through the heating tubes B in the same
5075 given time, yet the mass movement in the tank K-3 or tank K-5
will be so much slower that the oil will not be able to carry
in suspension the amount of free carbon or other solids that
it was able to carry in suspension while passing through the
heating tubes B, and therefore this excess carbon or other solids will settle out in said tank K-3 or tank K-5 and be drawn
off with the residuum through line N and which residuum can be
drawn off either intermittently or continuously, or no residuum
at all is drawn off and the free carbon and other solids allowed
Per A to ~~collect~~ in the bottom of the tanks K-3 or ~~tank~~ K-5, and when
an accumulation has been attained in either of these tanks, that
particular tank can be cut out from the apparatus, as already
described, and the said tank be cleaned and then be put into
operation and in the meantime accumulate the free carbon and

per A other solids *(WILL ACCUMULATE) in the other tank in the same manner. A fresh supply of raw material may be fed either continuously or intermittently into the apparatus through line M through pump J, through discharge line L-1 into the bottom of tank K-1. Steam or water or both may be fed into the apparatus through line Y into discharge line L either continuously or intermittently.

" A ~~According to~~ *(THE HIGHER) the velocity at which the oil is circulated through the heating tubes B, the higher will be the additional pressure on such oil while in said tubes over and above such pressure maintained on the resf of the apparatus, and in order to increase the pressure above that additional pressure that will be created on the oil by the velocity that it is desired to maintain the oil at in the heating tubes, I have placed a pressure regulating valve on the discharge line of these tubes and marked it D.

It will be seen that my method herein described, permits of the continuous treatment of petroleum wherein such petroleum

5076 is repeatedly subjected to a heating zone under a higher pressure than is maintained elsewhere on the apparatus; such heated oil repeatedly percolated up through a body of oil, repeatedly passes through a settling tank, and while passing through the latter two places the oil is freed of its vapor contents

* Matter in parentheses inserted.

which pass up in a reflux condenser wherein the heavy vapors
are condensed and automatically returned to the apparatus
while the remaining vapors pass on through the water cooled
condenser and are collected separately, while the remaining
unvaporized oil and condensate from the reflux condenser are
Per B again subjected to f*(U)rther heat treatment. It will also be
seen that by my herein described method the distillates from
the reflux condenser can be returned to the oil in the settling tank or returned practically direct to the suction side
per B of the circulation pump. It will f*(U)rther be seen that by
my method herein described I can use either water or steam or
both in the heating tubes and such water condensed in the reflux condenser, trapped and withdrawn from the apparatus or
automatically returned back to the heating tubes. It will
also be seen by my herein described method that I can distill
practically all the oil put into the apparatus without withdrawing from the apparatus any substantial amount of liquid
residue, but continue to feed fresh raw material into the
apparatus and yet not plug my heating tubes with carbon. It
will also be seen that by my method herein described the grade
of final distillate allowed to pass from the process is de-

* Matter in parentheses inserted.

finitely controlled by means of the reflux condenser.

The pressure that can be used on the apparatus will vary from zero to 1000 lbs per square inch, but in all cases the

per B. pressure ~~contained~~ on the oil while passing through the heating

5077 tubes will be more than the pressure maintained on the rest of the apparatus, and where such rest of the apparatus is over the pressure of one atmosphere, then such pressure

per B is reduced to, ~~or below~~ atmospheric pressure at D-1. It will be understood that the pressure maintained on the apparatus will be governed by the boiling point of the products

per A produced, and the quantity produced, and the temperature *(TO) ~~at~~

" A which the oil is subjected ~~to~~ in the heating tubes and whether heated in connection with water or steam or both, and these will vary according to the raw material used, all of which are of very considerable commercial value. In the method and apparatus here shown it will be noted that the condensation

per A of the final product *(IN THE WATER CONDENSER AND RECEIVING TANK) takes place

per B at ~~or below~~ atmospheric pressure and that there is no condensation under the pressure of the generative vapors.

It will be understood that while I herewith furnish drawings and describe a certain apparatus, yet I do not limit

*Matter in parentheses inserted.

myself to any particular construction of apparatus or arrangement of same, ~~other than to accomplish the principels brought out in this specification.~~

Sub. B1 B1

Carbon P Dubbs

5081 OATE.

State of Illinois } ss.
County of Cook }

Carbon P. Dubbs, the above-named petitioner, being first duly sworn, deposes and says that he is a citizen of the United States, residing in the City of Wilmette, County of Cook, and State of Illinois; that he verily believes himself to be the first, original and sole inventor of the new and useful Improvements in Method and Apparatus for Treating Hydrocarbon Oils described and claimed in the annexed specification; that he does not known and does not believe that the same was ever known or used before his invention or discovery thereof, or patented or described in any printed publication in any country before his invention or discovery thereof, or more than two years prior to this application, or in public use or on sale in the United States for more than two years prior to this application; that said invention has not been patented in any country foreign to the United States on an application filed by him, or his legal representatives or assigns, more than twelve months prior to this application; and that no application for patent on said improvements has been filed by him, or his legal representatives or assigns in any country foreign to the United States.

Carbon P. Dubbs.

Sworn to and Subscribed before me this 19th day of December, 1917.

A. L. Walsh,
Notary Public.

(Seal)

5090

Paper No. 5.

(Stamp) Mail Room Mar 26 1919 U. S. Patent Office. Docket Clerk Mar 26 1919 U. S. Patent Office. U. S. Patent Office Received Mar 28 1919.

UNITED STATES PATENT OFFICE.

In re Application of
Carbon P. Dubbs
Method & Apparatus for Treating
Hydrocarbon Oils
Ser. No. 208,206
Filed, December 21st, 1917
Hon. Commissioner of Patents,
Washington, D. C.
Sir:

In the matter of my above entitled application I hereby appoint Frank L. Belknap, 1014 First National Bank Building, Chicago, Illinois, my attorney to prosecute this application, to make the necessary alterations and amendments therein, to receive the Patent, and to transact all business in the Patent Office connected therewith.

Signed at Chicago, Illinois, this 24th day of March, 1919.

Carbon P. Dubbs.

Revenue Stamp

5111

Paper No. 13.

(Stamp) Application Room Jun 28 1922 U. S. Patent Office.

IN THE UNITED STATES PATENT OFFICE.

Div. 31, Room 172,
Carbon P. Dubbs,
Method and Apparatus for
Treating Hydrocarbon Oils,
Filed Dec. 21, 1917,
Serial No. 208206.
Hon. Commissioner of Patents,
Sir:

In the matter of the above entitled application, and responding to the Office Letter of October 31, 1921, the appli-

cant has been giving this application a very careful review prior to entering an appeal, and it is believed that certain subject matter is herein disclosed which has not been properly claimed in the past, and it is requested that the following claims be considered by the Examiner and allowed if he believes such claims to be drawn to patentable subject matter, and to be admitted for the purpose of appeal if he feels otherwise.

Cancel the claims and insert the following:

5113 5. A process of cracking oil, which comprises passing the oil through a series of small tubes in a heating zone, in maintaining the oil in said tubes under a superatmospheric pressure sufficient to prevent material vaporization thereof, in discharging the oil into an enlarged oil receiving means, and in stepping down the pressure in said oil receiving means to allow vaporization to occur therein, in discharging vapors from the oil in said oil receiving means to a reflux condenser, in returning reflux condensate to the heating tubes for further treatment, in returning the lighter portion of the residue in said enlarged oil receiving means to the heating tubes for retreatment, and in supplying fresh charging stock to said tubes with the reflux condensate and said lighter portion of the residue.

6. A process of cracking oil, which comprises passing the oil through a series of small tubes in a heating zone, in maintaining the oil in said tubes under a super-
5114 atmospheric pressure sufficient to prevent material vaporization thereof, in discharging the oil into an enlarged oil receiving means, and in stepping down the pressure in said oil receiving means to allow vaporization to occur therein, in discharging vapors from the oil in said oil receiving means to a reflux condenser, in returning reflux condensate to the heating tubes for further treatment, in returning the lighter portion of the residue in said enlarged oil receiving means to the heating tubes for retreatment, in supplying fresh charging stock to said tubes with the reflux condensate and said lighter portion of the residue, and in discharging heavy residuum from said enlarged oil receiving means.

5119

Carbon P. Dubbs,
By Frank L. Belknap,
Attorney.

June 23, 1922.
C.M.T.

 DX-816 (Excerpts from)

Pursuant to stipulation, the following matter, inadvertently omitted by the printer, should be read immediately prior to the signature on page 2976:

"A plant in accordance with this application has been put in actual use, and large increases in yields of gasoline have resulted.

"It is not a paper invention, and a plant has been actually tried in accordance therewith, and it is considered a very marked step forward in this art. In some of the claims the differential pressure is defined, and this is highly essential in a plant of this character. As the Examiner will appreciate, trouble will occur if substantial vaporization takes place in the coils. To prevent the precipitation of carbon due to vaporization, the applicant maintains a high pressure on the oil in the coil. To allow vaporization to freely occur in the enlarged oil receiving means, he steps down the pressure in this oil receiving means. This causes the precipitated carbon and the heavy oils to collect in the oil receiving means, where a means is provided to facilitate the discharge thereof from the system, while the lighter residue forming the top portion of the liquid in the oil receiving means is returned for retreatment separated from this heavy residuum. The use of the differential pressure in this particular type of plant is so highly advantageous that the operation of the plant is seriously impaired unless such pressure control is resorted to. Manifestly these claims should be allowed."

5183

DX 817.

Bulletin

Dubbs Cracking Process

Form B-536

1-15-26.

Subject: Coke Formation in Furnace Tubes at Start of Run (From Fire to Stream)

Coke formation in the furnace tubes is a source of trouble in any cracking process, and may give rise to undesirable conditions such as carbon spots, hot spots, decreased capacity, and general inefficiency in the operation of the plant. This, however, can be avoided, particularly at the start of a run, if proper precautions are taken when bringing up plant pressure and temperature before normal operating conditions are secured.

Never permit the transfer temperature to exceed 700° F. before 75 lbs. pressure has been reached. If the temperature is permitted to exceed that amount, vaporization will take place in the tubes, causing overheating and cracking of the oil vapors with the consequent deposition of carbon on the tube surfaces. This carbon will reduce the heat transmission through the walls of the tubes, causing them to become hot, and will also build up internal friction and restricted tube area, all resulting in decreased capacity.

There should be no difficulty in controlling operating conditions as noted above, and considering the ill effects which may otherwise result, it is very important that you strictly follow out these instructions.

Universal Oil Products Company
310 South Michigan Avenue
Chicago

5184 DX 818-A.

Chicago, Illinois.
F. 1016 N.R.

Summary of runs on a Standard 1500 Bbl. Dubbs Unit Equipped with a 90-4" Tube Furnace and Double 10'x40'x1⅝" Reaction Chambers.

Operating Pressure	190	190	190	190	190
Days on Stream	3.46	3.46	3.33	3.58	2.67
Charging Stock	85% Amarillo Residuum—15% P.D. Bottoms.				
Gravity A.P.I.	29.7	29.7	29.7	29.7	29.7
Total Bbls.	6372	6305	5672	6603	4997
Bbls. per Day on Stream	1842	1822	1703	1844	1872
Results of Cracking Press Dist.					
Total Bbls.	5532	5236	4551	5903	4258
Gravity A.P.I.	53.1	53.1	53.2	54.6	54.8
% Raw Oil	86.8	83.0	80.2	84.8	85.2
Residuum	Non Residuum Operation				
Unc. Gas & Coke					
Total Bbls.	840	1069	1121	1000	739
% Raw Oil	13.2	17.0	19.8	15.2	14.8
Coke					
Tons Produced	153.0	148.7	144.4	168.1	114.1
Lbs. per Bbl. Raw Oil	40.8	47.2	50.7	50.8	45.7
Results Distilling P.D. Gasoline 430 Cut Hemple					
Total Bbls.	4027	3822	3413	4213	3249
Bbls. per Day on Stream	1164	1105.	1025	1177	1217
% Raw Oil	63.2	60.6	60.1	63.8	65.0
% Press. Dist.	72.8	73.0	75.0	75.2	76.3
End Point.	437	437	437	437	437
Gas Oil (P.D. Botts)					
Total Bbls.	1228	1152	910	1165	839.
% Raw Oil	19.3	18.3	16.0	17.6	16.8
% Press. Dist.	22.2	22.0	20.0	20.8	19.7
Distillation Loss					
Total Bbls.	277	262	228	225	170
% Raw Oil	4.3.	4.1	4.1	3.4	3.4
% Press. Dist.	5.0	5.0	5.0	4.0	4.0

Note: All figures are based on charging stock being fed into system only once and do not include any rerunning.

5185

DX 818-B.

Chicago, Illinois.
F-9175

Comparison of an Average Run on Dubbs Unit having 10'x10' Reaction Chamber and 50 Tube Furnace with Runs on a Unit having 10'x30' Reaction Chamber and 62 Tube Furnace.

Press. Lbs.	175	175	175	175	175	182-200	175
Type Installat.	50 Tube Furnace Reflex Pump.			62 Tube Furnace Reflex Pump			
Size Chamber	10x10			10 x 30			
Days on Stream	3.83	4.17	4.87	5.21	6.95	4.33	4.19
Hours on Stream	92	100	117	125	167	104	118
Charging Stock							
75% Fuel Oil 25% Gr.	75% Fuel Oil 25% Gr.				79% Fuel Oil		
25% Gas Oil 34-35% Gr.	25% Gas Oil 34-35% Gr.				21% P.D. Botts		
Total Bbls. Charged	3179	3728	4472	4770	6728	3953	4484
Bbls./Day	829	895	917	916	967	913	913
Results of Cracking							
P.D. Total Bbls.	2078	2406	2984	3248	4672	2630	3019
Bbls./Day	542	578	612	624	672	607	614
% Raw Oil	65.4	64.5	66.7	68.1	69.4	66.5	67.3
Results Dist.							
Gasol. Total Bbls.	1405	1818	2157	2314	3147	1900	2143
Bbls./Day	367	437	443	445	453	439	437
% Raw Oil	44.2	48.8	48.2	48.5	46.8	48.0	47.8
% Pres. Dist.	67.6	75.5	72.2	71.2	67.3	72.2	71.0
Tons Coke Produced	32.75	57	44.5	40	52.5	41	42
Temperatures							
Above Tubes	1480/1510	1470	1460	1460	1470	1470	1460
Below Tubes	980/1050	965	1010	1015	985	980	985
Transfer	875/890	860	880	885	885	885	880

Note: All figures are based on charging stock being fed into system only once and do not include any rerunning.

5186 DX 818-C.

Chicago, Illinois.
F. 3286 N.R.

Summary of runs o na Standard 1500 Bbl. Dubbs unit equipped with a 90-4" Tube Furnace, and Double 10'x40'x1⅝" Reaction Chamber.

Operating Pressure	150-175	175	175	175	175
Days on Stream	3.12	3.92	2.37	3.83	3.62
Charging Stock			Amarillo Residuum		
Gravity A.P.I.	28.4	28.4	28.4	28.4	28.4
Total Bbls.	5851	6871	4404	6404	6030
Bbls. per Day on Stream	1875	1898	1858	1672	1666
Results of Cracking					
Press. Dist.					
Total Bbls.	4804	5629	3413	5415	4741
Gravity A.P.I.	53.3	53.3	54.5	54.3	54.6
% Raw Oil	82.1	86.9	77.5	84.5	78.6
Residuum			Non Residuum		
Fuel Gas & Coke					
Total Bbls.	1047	1242	991	989	1289
% Raw Oil	17.9	18.1	22.4	15.5	21.4
Coke					
Ton Produced	133.5	153.0	109.8	163.8	103.0
Lbs. per Bbl. Raw Oil	45.7	44.5	49.8	51.1	50.7
Results Distilling P.D.					
Gasoline 430 Cut Hemple					
Total Bbls.	3302	4053	2775	4115	3707
Total Bbls. per Day on Stream	1087	1120	1171	1074	1024
% Raw Oil	58.0	59.0	63.0	64.2	61.5
% Press. Dist.	70.6	72.0	81.3	76.0	78.2
End Point	437	437	437	437	437
Gas Oil (P.D. Botts)					
Total Bbls.	1172	1351	592	1083	844
% Raw Oil	20.0	19.7	11.4	16.9	14.0
% Press. Dist.	24.4	24.0	14.7	20.0	17.8
Distillation Loss					
Total Bbls.	240	225	136	217	190
% Raw Oil	4.1	3.2	3.1	3.4	3.1
% Press. Dist.	5.0	4.0	4.0	4.0	4.0

Note: All figures are based on charging stock being fed into system only once and do not include any rerunning.

5187 **DX 818-D.**

Chicago, Illinois.
F. 9306 N.R.

Summary of runs on a Standard 1500 Bbl. Dubbs unit equipped with a 90-4" Tube Furnace and Double 10'x40'x1⅝" Reaction Chamber.

Operating Pressure	190	190	190	190	190
Days on Stream	2.92	3.08	3.25	3.0	3.21
Charging Stock			Amarillo Residuum		
Gravity A.P.I.	28.4	28.4	28.4	28.4	28.4
Total Bbls.	5507	5634	5733	5521	5956
Bbls. per Day on Stream	1886	1836	1764	1840	1856
Results of Cracking					
Press. Dist.					
Total Bbls.	4650	4636	4568	4555	4930
Gravity A.P.I.	54.1	54.0	54.2	54.5	54.2
% Raw Oil	84.4	82.3	79.7	82.5	82.8
Residuum			Non Residuum		
Unc. Gas & Coke					
Total Bbls.	857	998	1165	966	1026
% Raw Oil	15.6	17.7	20.3	17.5	17.2
Coke					
Tons Produced	137.9	146.1	137.9	131.4	135.7
Lbs. per Bbl. Raw Oil	50.0	51.8	48.1	47.6	45.6
Results Distilling P.D.					
Gasoline 430 Cut Hemple					
Total Bbls.	3427	3537	3517	3280	3584
Bbls. per Day on Stream	1174	1148	1082	1093	1117
% Raw Oil	62.2	62.8	61.4	59.4	60.2
% Press. Dist.	73.7	76.3	77.0	72.0	72.7
End Point	437	437	437	437	437
Gas Oil (P.D. Botts)					
Total Bbls.	1037	913	808	1048	1099
% Raw Oil	18.8	16.2	15.1	19.0	18.4
% Press. Dist.	22.3	19.7	19.0	23.0	22.3
Distillation Loss					
Total Bbls.	186	183	183	227	247
% Raw Oil	3.4	3.3	3.2	4.1	4.2
% Press. Dist.	4.0	4.0	4.0	5.0	5.0

Note: All figures are based on charging stock being fed into system only once and do not include any rerunning.

5188 **DX 818-E.**

Chicago, Illinois.
F-10136 N.R.

Summary of runs on a Standard 1500 Bbl. Unit Equipped with a 90-4" Tube Furnace and Double 10'x40'x1⅝" Reaction Chambers.

Operating Pressure	190	190	190	190	190
Days on Stream	3.42	3.50	3.21	3.33	3.42
Charging Stock	85% Amarillo Residuum—15% P.D. Bottoms				
Gravity A.P.I.	29.7	29.7	29.7	29.7	29.7
Total Bbls.	6356	6255	5889	5906	6170
Bbls. per Da. on Str.	1853	1787	1835	1774	1804
Results of Cracking					
Press. Dist.					
Total Bbls.	5091	5092	5396	5222	5446
Gravity A.P.I.	54.0	54.8	55.5	54.2	55.2
% Raw Oil	80.1	81.4	91.6	88.4	88.2
Residuum	Non Residuum Operation				
Unc. Gas & Coke					
Total Bbls.	1265	1163	493	684	724
% Raw Oil	19.9	18.6	8.4	11.6	11.8
Coke					
Tons Produced	137.9	140.0	148.7	146.5	142.2
Lbs. Per Bbl. R.O.	43.4	44.8	50.5	49.6	46.1
Results Distilling P.D.					
Gasoline 430 Cut Hemple					
Total Bbls.	3828	3829	4004	3901	4084
Bbls. Per Da. On Str.	1119	1094	1247	1172	1194
% Raw Oil	60.2	61.2	68.0	66.1	66.2
% Press. Dist.	75.2	75.2	74.2	74.7	75.0
End Point	437	437	437	437	437
Gas Oil (P.D. Botts)					
Total Bbls.	1008	1008	1176	1069	1089
% Raw Oil	15.9	16.1	20.0	17.9	17.6
% Press. Dist.	19.8	19.8	21.8	20.3	20.0
Distillation Loss					
Total Bbls.	255	255	216	261	273
% Raw Oil	4.0	4.1	3.6	4.4	4.4
% Press. Dist.	5.0	5.0	4.0	5.0	5.0

Note: All figures are based on charging stock being fed into system only once and do not include any rerunning.

5189

DX 818-F.

Chicago, Illinois.
F-10216 N.R.

Summary of runs on a Standard 1500 Bbl. Unit Equipped with a 90-4" Tube Furnace and Double 10'x40'x1⅝" Reaction Chambers.

Operating Pressure	190	190	190	190	190
Days on Stream	3.67	3.58	3.12	3.62	4.0
Charging Stock	85% Amarillo Resid.—15% P.D. Bottoms				
Gravity A.P.I.	29.7	29.7	29.7	29.7	29.7
Total Bbls.	6863	6398	5584	6772	6760
Bbls. per Day on Stream	1870	1787	1790	1871	1690
Results of Cracking					
Press. Dist.					
Total Bbls.	5835	5708	4903	5948	5643
Gravity A.P.I.	54.4	53.2	52.3	52.4	53.5
% Raw Oil	85.0	89.2	87.8	87.8	83.5
Residuum	Non-Residuum Operation				
Unc. Gas & Coke					
Total Bbls.	1028	690	681	824	1117
% Raw Oil	15.0	10.8	12.2	12.2	16.5
Coke					
Tons Produced	170.3	163.8	142.2	165.9	159.5
Lbs. per Bbl. Raw Oil	49.6	51.2	50.9	49.0	47.2
Results Distilling P.D.					
Gasoline 430 Cut Hemple					
Total Bbls.	4388	4064	3653	4402	4221
Bbls. per Day on Stream	1196	1135	1171	1216	1055
% Raw Oil	63.9	63.5	65.4	65.0	62.4
% Press. Dist.	75.2	71.2	74.5	74.0	74.8
End Point	437	437	437	437	437
Gas Oil (P.D. Botts)					
Total Bbls.	1155	1359	1005	1249	1140
% Raw Oil	16.8	21.2	18.0	18.4	16.9
% Press. Dist.	19.8	23.8	20.5	21.0	20.2
Distillation Loss					
Total Bbls.	292	285	245	297	282
% Raw Oil	4.3	4.5	4.4	4.4	4.2
% Press. Dist.	5.0	5.0	5.0	5.0	5.0

Note: All figures are based on charging stock being fed into system only once and do not include any rerunning.

5190 DX 818-G.

Chicago, Illinois.
F-11106 N.B

Summary of runs on a Standard 1500 Bbl. Unit Equipped with a 90-4" Tube Furnace and Double 10'x40'x1⅝" Reaction Chambers.

Operating Pressure	190	190	190	190	190
Days on Stream	3.83	3.50	3.25	3.17	3.92
Charging Stock	85% Amarillo Residuum—15% P.D. Bottoms.				
Gravity A.P.I.	29.7	29.7	29.7	29.7	29.7
Total Barrels	7220	6425	6022	6275	6498
Bbls. per Day on Stream	1885	1836	1853	1980	1658
Results of Cracking Press. Dist.					
Total Bbls.	5969	5602	4840	5471	5662
Gravity A.P.I.	54.0	52.6	53.9	53.2	53.7
% Raw Oil	82.7	87.2	80.4	87.2	87.1
Residuum	Non Residuum Operation				
Unc. Gas & Coke					
Total Bbls.	1251	823	1182	804	836
% Raw Oil	17.3	12.8	19.6	12.8	12.9
Coke					
Tons Produced	172.4	157.3	142.2	157.3	153.0
Lbs. per Bbl. R.O.	47.7	48.9	47.2	50.1	47.1
Results Distilling Press. Dist.					
Gasoline 430 Cut Hemple					
Total Bbls.	4560	4168	3654	4049	4371
Bbls. per Day on Stream	1190	1191	1124	1277	1115
% of Raw Oil	63.2	64.9	60.7	64.5	67.2
% Press. Dist.	76.4	74.4	75.5	74.0	77.2
End Point	437	437	437	437	437
Gas Oil (P.D. Botts.)					
Total Bbls.	1110	1154	944	1149	1008
% Raw Oil	15.4	17.9	15.7	18.3	15.5
% Press. Dist.	18.6	20.1	19.5	21.0	17.8
Distillation Loss					
Total Bbls.	299	280	242	273	283
% Raw Oil	4.1	4.4	4.0	4.4	4.4
% Press. Dist.	5.0	5.0	5.0	5.0	5.0

Note: All figures are based on charging stock being fed into system only once and do not include any rerunning.

5191 DX 818-H.

Chicago, Illinois.
G 865.

Comparison of runs on standard 500 barrel unit without Reflux Pump but with and without U. O. P. Company Flue Gas Recirculating System.

Run No.	Avg. Six Runs	19	20	5	8	9	10
Press. Lbs.	170	200	180–200	160–190	200	170	135–180
Type Installat.	Standard Plan.			Flue Gas Circulating System installed			Flue Gas Circ. system & Vapor line heat Exc.
Type Feed	Direct	Split	Split	Direct	Split	Split	Split
Size Chamber	~~10x15~~	~~10x15~~	10x15	10x15	10x15	10x15	10x15
Da. on Stream	——	17.4	16.3	13.6	5.79	21.0	6.58
Hrs. on Stream	——	417	391	327	139	505	158
Charging Stock:	Mixd. Fuel	Strt. Fuel	Mixd. Fuel	Resid. St.Fuel	Strt. Fuel	Strt. Fuel	Resid. St.Fuel
Be.Gr.	35.0	38–40	30–40	40.0	36.8-39.6	38.2-39.8	30–39
Total Bbl. Chg.	——	8163	8235	7345	3110	10142	3640
Bbl./Da. O.S.	475	470	505	554	526	482	553
Results Cracking							
P.D. Total Bbls.	——	6428	5711	5405	2270	7507	2669
Bbls./Da.	327	370	351	397	384	357	406
% Raw Oil	78.0	78.7	69.4	71.64	72.9	74.11	73.3
Be. Gr. Residuum	50.0	52.0	52.0	51.8	55.6	52.0	50.0
Gravity	——	——	——	31.0	——	29.0	18.27
Tons Coke Est.	——	——	——	16	——	27.	——
Fuel Consumption							
F.O. Burned	——	838	937	508	——	818	225
Gas Burned Cu.Ft.	——	none	none	328500	none	none	none
Total % R.O. from firing	——	10.3	11.4	7.8	——	8.08	6.2
Total % R.O. on stream	1.11Est.	10.02	11.15	7.6	8.1	7.75	5.46
Results Distilling P.D.							
Gasoline, Bbls.	——	3563	3290	2993	1425	4381	1349
Bbl./Da. O.S.	182	205	202	220	241	208	205
% Raw Oil	38.45	43.6	40.0	39.66	45.8	45.19	37.1
% P.D.	55.9	55.3	57.5	55.4	62.8	58.4	50.6
End-Point	———			420 Cut on Hemple Column			———
Gas Oil							
Total Bbls.	——	2607	2201	2221	746	2848	1210
% Raw Oil	——	31.9	2[illegible].7	29.4	24.0	28.1	33.2
% P.D.	——	3.2	[illegible].7	2.54	3.1	2.7	4.5

Note: All figures are based on charging stock being fed into system only once and do not include any rerunning.

5192 DX 818-I.

Chicago, Illinois.
G-936 NR

Summary of runs on a Standard 1000 barrel Dubbs Unit equipped with a 90-4" Tube Furnace and Double 10' x 40' x 15/8" Reaction Chamber.

Chambers in Operation	1	2	2	1
Operating Pressure	175	190-175	190	190
Days on Stream	2.96	5.17	4.46	3.08
Charging Stock		Mid Continent Gas Oil		
Gravity A.P.I.	31.2	33.8-31.2	33.8-31.2	33.8
Total Bbls.	4399	7452	6880	4553
Bbls. per Day on Stream	1486	1441	1543	1478
Results of Cracking				
Press. Dist.				
Total Bbls.	3928	6855	6136	3977
Gravity A.P.I.	50.6	50.2	51.4	50.8
% Raw Oil	89.3	91.8	89.2	87.3
Residuum	None	None	None	None
Unc. Gas & Coke				
Total Bbls.	471	597	744	576
% Raw Oil	10.7	9.2	10.8	12.7
Coke				
Tons Produced	73.2	125.0	118.4	73.2
Lbs. per Bbl. Raw Oil	33.3	33.5	34.4	32.2
Results Distilling Press. Dist.				
Gasoline 430 Cut Hemple				
Total Bbls.	2561	4284	3878	2545
Bbls. per Day on Stream	865	829	870	826
% Raw Oil	58.2	57.4	56.4	55.9
% Press. Dist.	65.2	62.5	63.2	64.0
End Point	437	437	437	437
Gas Oil (P.D. Botts)				
Total Bbls.	1131	2022	1767	1114
% Raw Oil	25.7	27.1	25.7	24.4
% Press. Dist.	28.8	29.5	28.8	28.0
Distillation Loss				
Total Bbls.	236	549	491	318
% Raw Oil	5.4	7.3	7.1	7.0
% Press. Dist.	6.0	8.0	8.0	8.0

Note: All figures are based on charging stock being fed into system only once and do not include any reruning.

5193 DX 818-J.

Chicago, Illinois.
G. 6106

Dubbs Cracking Process.

Summary of a run in a Standard 500 Barrel Dubbs Unit equipped with a 50 Tube Furnace, Reflux Pump and single 10′ x 15′ x 1¼″ reaction Chamber.

Operating Pressure	150
Hours on Stream	64
Total Days on Stream	2.67
Charging Stock	Eldorado Southfield P. D. Bottoms
Gravity A. P. I.	34.6
Total Bbls.	1673
Total Bbls. per Day on Stream	627
Results of Cracking	
Press. Dist. Total Bbls.	1241
Gravity A. P. I.	52.5
% Raw Oil	74.2
Residuum Total Bbls.	289
Gravity A. P. I.	17.5
% Raw Oil	17.3
Unc. Gas & Coke, Total Bbls.	143
% Raw Oil	8.5
Coke Tons Produced	11
Lbs. per Bbl. Raw Oil	13.15
Fuel Consumption	Not Measured
Results Distilling Press. Dist.	
Gasoline 430 Out (Hemple)	
Total Bbls.	993
Total Bbls. per Day on Stream	372
% Raw Oil	59.4
% Press. Dist.	80.0
I. B. P.-E. P.	116-432
Gravity A. P. I.	54.9
Gas Oil (P. D. Bottoms) Total Bbls.	174
% Raw Oil	10.4
% Press. Dist.	14.0
Distillation Loss Total Bbls.	74
% Raw Oil	4.4
% Press. Dist.	6.0

Note: All figures are based on charging stock being fed into system only once and do not include any rerunning.

5194 DX 818-K.

Chicago, Illinois.
G-6156

Dubbs Cracking Process

Summary of a run on a 1000 Barrel Dubbs Unit equipped with a 90—4″ Tube Furnace, Reflux Pump and Double 10′ x 40′ x 2″ Reaction Chambers operated in parallel. Residuum Operation 3.42 Days Non-residuum Operation 4.0 days.

Operating Pressure	190-200
Hours on Stream	178
Days on Stream	7.42
Charging Stock	Mid Continent Gas Oil
Gravity A. P. I.	32.3
Total Barrels	10791
Barrels per day on Stream	1454
Results of Cracking	
Press. Dist. Total Barrels	8124
Gravity A. P. I.	55.1
% Raw Oil	75.4
Residuum Total Barrels	1287
Gravity A. P. I.	24.3
% Raw Oil	11.8
Unc. Gas & Coke Total Barrels	1390
% Raw Oil	12.8
Coke Tons Produced	139.0
Lbs. per Barrel of Raw Oil	25.8
Fuel Consumption	Not Measured
Results Distilling Press. Dist.	
Gasoline 430 Cut (Hemple) Total Barrels	5963
Barrels per Day on Stream	804
% Raw Oil	55.3
% Press. Dist.	73.4
End Point	437
Gas Oil (P. D. Bottoms) Total Barrels	1755
% Raw Oil	16.3
% Press. Dist.	21.6
Distillation Loss Total Barrels	406
% Raw Oil	3.7
% Press. Dist.	5.0

Note: All figures are based on charging stock being fed into system only once and do not include any rerunning.

5195 DX 818-L.

Chicago, Illinois.
G-6166

Dubbs Cracking Process

Summary of a run on a 1000 Barrel Dubbs Unit equipped with a 90—4″ Tube Furnace, Reflux Pump and Double 10′ x 40′ x 2″ Reaction Chambers operated in parallel.
Residuum Operation 5.5 Days Non-Residuum operation 4.5 Days.

Operating Pressure	190-200
Hours on Stream	240
Days on Stream	10.0
Charging Stock	Mid Continent Gas Oil
Gravity A. P. I.	32.2
Total Barrels	14950
Barrels per Day on Stream	1495
Results of Cracking	
Press. Dist. Total Barrels	10788
Gravity A. P. I.	52.9
% Raw Oil	72.2
Residuum Total Barrels	2230
Gravity A. P. I.	23.0
% Raw Oil	14.9
Unc. Gas & Coke Total Barrels	1932
% Raw Oil	12.9
Coke Tons Produced	168.2
Lbs. per Barrel Raw Oil	22.5
Fuel Consumption	Not Measured
Results Distilling Press. Dist.	
Gasoline 430 Cut Hemple	
Total Barrels	7552
Barrels per Day on Stream	755
% Raw Oil	50.5
% Press. Dist.	70.0
End Point	437
Gas Oil (P. D. Bottoms) Total Barrels	2589
% Raw Oil	17.3
% Press. Dist.	24.0
Distillation Loss Total Barrels	647
% Raw Oil	4.4
% Press. Dist.	6.0

Note: All figures are based on charging stock being fed into system only once and do not include any rerunning.

5196 DX 818-M.

Chicago, Illinois.
G-6186 N. R.

Dubbs Cracking Process

Summary of a run in a Standard 800 Barrel Dubbs Unit equipped with a 62 Tube Furnace, Reflux Pump and Single 10′ x 30′ x 1⅝″ Reaction Chamber.

Operating Pressure	200
Hours on Stream	96.0
Days on Stream	4.0
Charging Stock	Kevin Sunburst Gas Oil
Gravity A. P. I.	29.1
Total Bbls.	2396
Barrels per Day on Stream	599
Results of Cracking	
Pressure Dist. Total Bbls.	2000
Gravity A. P. I.	49.4
% Raw Oil	83.48
Residuum Total Bbls.	Non-Residuum
Unc. Gas & Coke Total Bbls.	395
% Raw Oil	16.52
Coke Tons Produced	51.9
Lbs. per Bbl. of Raw Oil	43.3
Fuel Consumption Total Bbls.	38.1
% Raw Oil	1.59
Results Distilling Press. Dist.	
Gasoline 432 Cut Hemple	
Total Bbls.	1444
Bbls. per Day on Stream	361
% Raw Oil	60.27
% Press. Dist.	72.2
IBP-EP	100-434
Gravity A. P. I.	52.5
Gas Oil (P. D. Bottoms)	
Total Bbls.	444
% Raw Oil	18.5
% Press. Dist.	22.2
Distillation Loss Total Bbls.	112
% Raw Oil	4.67
% Press. Dist.	5.6

Note: All figures are based on charging stock being fed into system only once and do not include any rerunning.

5197 DX 818-N.

Chicago, Illinois.
G-6256 N. R.

Summary of a Run in a Standard 800 Barrel Dubbs Unit equipped with a 62 Tube Furnace, Reflex Pump and Single 10' x 30' x 1⅝" Reaction Chamber.

Operating Pressure	200
Hours Fire to Stream	7
Hours on Stream	89
Hours Cleaning	19
Complete Cycle Hours	115
Days on Stream	3.71
% Time on Stream	77.39
Charging Stock	Kevin Sunburst Gas Oil
Gravity A. P. I.	28.5
Total Bbls. (Gauge)	2292
Barrels per Day on Stream	618
Barrels per Day on Cycle	478
Results of Cracking	
Pressure Dist. Total Bbls. (Gauge)	1938
Gravity A. P. I.	50.3
% Raw Oil	84.56
Residuum Total Bbls.	Non-Residuum
Unc, Gas & Coke Total Bbls.	354
% Raw Oil	15.44
Coke Tons Produced	62
Lbs. per Bbl. of Raw Oil	54.3
Fuel Consumption Total Bbls. (Liquid)	29.76
% Raw Oil	1.30
Results Distilling Press. Dist.	
Gasoline 437 Cut Hemple	
Total Bbls.	1465
Bbls. per Day on Stream	395
Bbls. per Day on Cycle	306
% Raw Oil	63.92
% Press. Dist.	75.6
IBP—EP	96-437
Gravity A. P. I.	52.3
Gas Oil (P. D. Bottoms)	
Total Bbls.	333.2
% Raw Oil	14.54
% Press. Dist.	17.2
Distillation Loss Total Bbls.	139
% Raw Oil	6.08
% Press. Dist.	7.2

Note: All figures are based on charging stock being fed into system only once and do not include any rerunning.

2992 *DX 818-O.*

5198 DX 818-O.

Chicago, Illinois.
G-7226 N. R.

Summary of a Run in a Standard Dubbs Unit equipped with a 62 Tube Furnace, Reflux Pump and Single 10' x 30' x 1⅝" Reaction Chamber.

Operating Pressure	200
Hours Fire to Stream	7.5
Hours on Stream	85
Hours Cleaning	14.5
Complete Cycle Hours	107.0
Days on Stream	3.54
% Time on Stream	79.4
Charging Stock	Kevin Sunhurst Gas Oil
Gravity A. P. I.	30.4
Total Barrels (Gauge)	2109
Barrels per Day on Stream	596
Barrels per Day on Cycle	473
Results of Cracking	
Pressure Distillate Total Bbls. (Gauge)	1710
Gravity A. P. I.	50.1
% Raw Oil	81.1
Residuum	None
Unc. Gas & Coke Total Bbls.	399
% Raw Oil	18.9
Coke Tons Produced	55.6
Lbs. per Barrel of R. O.	52.6
Results Distilling Press. Dist.	
Gasoline (437) Cut Hemple	
Total Barrels	1300
Barrels per day on Stream	367
Barrels per Day on Cycle	292
% Raw Oil	61.6
% Press. Dist.	76.0
End Point	437
Gas Oil (P. D. Bottoms)	
Total Barrels	307
% Raw Oil	14.6
% Press. Dist.	18.0
Distillation Loss Total Barrels	103
% Raw Oil	4.9
% Press. Dist.	6.0

Note: All figures are based on charging stock being fed into system only once and do not include any rerunning.

5199 DX 819.

Cracking

Yesterday, Today and Tomorrow

What is cracking?

It is distillation under high pressure. In the cracking process the oil which has been stripped of all its gasoline is heated above its boiling point, but the pressure chokes back boiling or vaporization until a chemical riot completely changes its nature. The big molecules which make up the oil are shattered—"cracked" into small ones which make up anti-knock gasoline.

5200 Universal Oil Products Co. Dubbs Cracking Process

Chicago, Illinois Owner and Licensor

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5201 DX 820.

Bulletin

Dubbs Cracking Process

Service Department

No. SR-508
6-20-32
Pg. 1

Pressure on System at Start of Run

(1) The object of using pressure at the start of the run is to raise the boiling range of the oil passing through the tubes and thus retard vaporization. It is advisable to maintain as high a pressure as is practical on the system within the allowable pressure operating limit from the time the fires are lighted. At the start this pressure will be the residual liquid pressure remaining on the unit after the hydrostatic test pressure has been reduced. In accomplishing this purpose not only is coking in the tubes minimized, but the cracking reaction commences at an earlier stage in the "coming on stream" period than would be possible otherwise. Thus the normal operating conditions will be established in the shortest period of time.

5203 DX 821:

Bulletin

Dubbs Cracking Process

Service Department

No. SR-521
6-20-32
Pg. 1

Hot Oil Pumps

General

(1) The efficient and safe operation of a Dubbs cracking unit is dependent, to a high degree, on smooth and uniform delivery of the hot oil pump. Both smoothness and uniform delivery are seriously influenced by:

(d) Insufficient static head to overcome all losses between the tower and the pump, thus failing to avoid any tendencies toward vaporization by pressure reduction.

5204 DX 825 (EXCERPT).

Principles of Chemical Engineering, by William H. Walker, Warren K. Lewis and William H. McAdams (1923), at pp. 381, 478:

"If the liquid is in a space in which the partial pressure of its vapor is less than the vapor pressure it possesses at this temperature, it will proceed to vaporize and its vapor will pass into space. But this change of state is accompanied by the large absorption of heat already noted. If this heat be not supplied from some external source, vaporization will nevertheless continue, and the necessary heat will be taken from the sensible heat of the liquid, with a consequent reduction of temperature. This fall in temperature of the liquid is accompanied by a corresponding decrease in vapor pressure. Finally a temperature is reached where the vapor pressure of the liquid is equal to its partial pressure existing in the space and vaporization will cease.

"Therefore, in order for vaporization to continue, two conditions must be met:

"First—the heat necessary for vaporization must be continuously supplied.

"Second—the equilibrium which forms between the vapor pressure of the liquid and its partial pressure in the surrounding space must be continuously destroyed.

"If either one of these two conditions be neglected vaporization will be retarded or even stopped.

"By far the most important processes for drying liquids and solids depend upon first vaporizing the water and in this form separating it from the structure of which it formed a part."

5205

DX 826 AND DX 826-A.

DEPARTMENT OF COMMERCE

United States Patent Office

To all persons to whom these presents shall come, Greeting:

This is to certify that the annexed is a true copy from the records of this office of the File Wrapper and Contents, in the matter of

Interference Number 52,305;

Holmes, Manley and Behimer vs. Dubbs,

Subject Matter:—

Converting Hydrocarbon Oils.

In Testimony Whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed, at the City of Washington, this twenty-fifth day of April, in the year of our Lord one thousand nine hundred and thirty-two and of the Independence of the United States of America the one hundred and fifty-sixth.

(Seal) Thomas E. Robertson
Commissioner of Patents.

Attest:

D. E. Wilson
Chief of Division.

2996 *DX 826 and DX 826-A (Excerpts from).*

5405 IN THE UNITED STATES PATENT OFFICE.

Before the Honorable Law Examiner.

Carbon P. Dubbs
vs.
Holmes, *et al.* } Interference No. 52,305.

BRIEF IN OPPOSITION TO MOTION FOR DISSOLUTION BROUGHT BY HOLMES, ET AL.

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5414 As is perfectly obvious, in these claims, as in the art, "vaporization" is used synonymously with "conversion." The operation is that the oil is heated in a coal of small diameter to a temperature somewhat above the

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5415 optimum cracking temperature, without a great amount of vaporization occurring, which means without a large amount of cracking occurring. It is then discharged into a large chamber, where the major part of the vaporization, or cracking occurs. To the man skilled in the art, there is no substantial difference in reference to these actions between the Dubbs set-up and that of Holmes, Manley and Behimer.

209

5426 Respectfully submitted,
Carbon P. Dubbs,
By William G. Hall
Chas. M. Thomas
Attorneys.

220

5671 DX 827-A.

IN THE DISTRICT COURT OF THE UNITED STATES.

District of New Jersey.

The Texas Company,
Plaintiff,
vs.
Warner-Quinlan, Inc.,
Defendant.
} In Equity No. E-309.

EXCERPTS FROM BRIEF FOR DEFENDANT PREPARED AND FILED BY ITS COUNSEL THOMAS G. HAIGHT, ALEXANDER F. REICHMANN, WILLIAM F. HALL AND CHARLES M. THOMAS, CHARACTERIZING AND DESCRIBING DUBBS' PROCESS OF DEFENDANT WARNER-QUINLAN, INC.

* * * * * *

Defendant is using the internationally employed Dubbs cracking process for treating low Baumé gravity oil, such as gas oil of about 350 Baumé, or even fuel oil (the process is unique in handling fuel oil, Wilson, R-X Qs. 8064, 8065, Rec., p. 10938), for recovering as a distillate a high Baumé gravity oil, a large fraction of which is a grade of gasoline equal or superior to that obtained by fractionally distilling crude oil.

* * * * * *

This process is so designed and contrived that it can be run continuously for a period of at least six days, with a through-put of over 136,000 gallons of fresh oil.

On January 15, 1929, there were 252 of the Dubbs units completed, or in the course of construction having a yearly producing capacity of over four billion gallons of gasoline. There were then over seventy-one licenses operating under the Dubbs patents. The construction costs involved an expenditure of over $45,000,000 (Deft. Ex. 148).

* * * * * *

2. Defendant's Process and Apparatus, I. E., The Dubbs Process and Apparatus Are Radically Different From Adams'.

1. Defendant's process is always carried out at relatively low temperatures, way below Adams' temperature range and corresponding more closely to the temperatures used in the old prior art. In defendant's process the oil is uniformly heated in an unrestricted stream caused by passing the oil through a very long heating tube (approximately 1500') located in a suitable furnace.

2. Defendant's process is a continuous process (a once through process as contradistinguished from the batch cyclic system" and the once treated, dirty oil is never recirculated.

3. The oil in defendant's process passes to a very large reaction chamber entirely separated from the heating element or coil, in which enlarged chamber most of the cracking takes place.

5672 5. Defendant's process is always operated at high pressure (between 150 and 180 pounds), far beyond anything ever contemplated, or disclosed, by Adams. This superatmospheric pressure in defendant's process is produced and maintained throughout the entire system, including the condenser and receiver by means of the self-generated vapors and incondensible gases. The vapors are not only condensed under pressure but gas separation from the distillate also takes places under the same pressure.

6. Defendant's process is a liquid phase process. Adams' process, due to the extremely high temperature used is a vapor phase process, irrespective of any pressure that could be maintained.

Defendant's Process.

Defendant employs the Dubbs process, the importance of which to the industry we have pointed out.

Defendant's set-up is illustrated by drawings, Defendant's Exhibit 1 and Plaintiff's Exhibit 17 and by models, Defendant's Exhibits 32 to 35.

Its construction and operation is clearly and succinctly

described by Dr. Walker (Rec., Q. 421; pp. 2461 to 2472; Q. 460, p. 3546; Qs. 464 to 466, p. 3549; Q. 469, p. 3551; Q. 471, p. 3552), and it is also described somewhat more in detail as to the specific temperatures and the like, by Mr. Seguy (Rec., pp. 2477 to 2479, 2483 to 2486, 2489, 2490, 2493 to 2510, 2513 to 2517, 3387, 3388).

Considering this set-up generally, it includes a furnace having a top temperature of approximately 1400 to 1500 degrees F. (Seguy, X-Q. 744, p. 3214; Yetter, Qs. 81, 83, p. 3037) and in the flue of the furnace is located a heating coil 1,500 feet long, made up of 50 four-inch tubes, each 30 feet long, connected to one another at their ends by U-bends, or coupling members (Seguy, Q. 17, pp. 2478, 2479).

This 1500 feet of piping is unrestricted from end to end. No core, no scraper, or anything else impedes, or retards, the flow of oil therethrough (Walker, Q. 471, p. 3552; Seguy, Qs. 19, 20, p. 2479). The oil courses through in a solid stream, save for such vaporization as may occur and is uniformly heated.

A transfer line lead from the discharge end of the coil through the side of the furnace, then upwardly and downwardly to discharge into the top of a reaction chamber. This is located wholly outside of the furnace, remote from the heating coil and away from the hazard of fire, which might be caused by a leak in a tube, or the like (Seguy, Qs. 29 to 31, p. 2483).

The reaction chamber is 10 feet in diameter and 15 feet in length along its vertical axis. It consists of a cylindrical portion 10 feet by 10 feet, and convex-shaped head (Seguy, Q. 22, p. 2483; Q. 53, p. 2493).

In operation, a body of oil is maintained in the reaction chamber the surface of which is from about a half to about three-quarters of the height thereof (Yetter, X-Qs. 238 to 240, p. 3064).

The oil never flows from the reaction chamber to the heating coil. The plant is incapable of operation in that way (Walker, p. 3518).

The oil in the reaction chamber never exerts any pressure upon the oil in the heating coil. The plant is incapable of operating in that way (Wilson, X-Qs. 4027, 4028, p. 1698).

In so far as its functions are concerned the top of
5673 the reaction chamber might be below the horizontal plane of the heating coil.

Practically all of the carbon formed during a run is precipitated in the reaction chamber, and accumulates therein (Seguy, Qs. 82, 83, p. 2508). This amounts to from 10 to 15 tons (Rec., pp. 3077-8).

During the operation the once treated, heavy, dirty carbon containing oil is constantly drawn off from the lower part of the reaction chamber, and this oil is never passed through the system again, or used in a cracking operation. This oil is taken off from the reaction chamber at three levels, at different times during the run. During the commencement of the run, it is taken off from the extreme bottom of the chamber, and as carbon accumulates in the chamber and closes the first take-off, the valve on the second take-off is opened, and as the carbon accumulates above its level, the valve on the third take-off is opened (Walker, pp. 2471-2472).

The oil is forced through the heating coil at a very rapid rate—reaching about 10 feet per second at the end of the coil—and is consequently in the coil for not more than about five minutes.

The oil is heated in the coil to a temperature of approximately 830 to 850 degrees F. (Yetter, Q. 87, p. 3037; Seguy, X-Q. 891, p. 3287). Temperatures as high as 890 to 900 degrees F. are not used, though they can be reached accidently for a few minutes (Yetter, X-Qs. 214-222, pp. 3060-1; Seguy, X-Q. 891, p. 3287). The entire contents of the coil is discharged through a transfer line into the reaction chamber, where the cracking reaction is completed. The oil remains therein, on an average, for about an hour.

All of the vapors which are discharged into the reaction chamber from the transfer line and all of the vapors which are formed from the oil in the cracking chamber, pass out of the top of the same through a vapor line to a dephlegmator (Walker, p. 2464).

No vapors formed in the heating coil ever pass Upwardly Through the oil in the reaction chamber.

The top of the dephlegmator is approximatelly 80 feet above the bottom of the heating coil and it comprises a shell about 21 feet long and 3½ feet in diameter, having arranged in staggered and spaced apart relation therein a series of pans, and having located in its top a ring-shaped spray pipe connected by a line, including a pump, to the pressure distillate receiver, so that pressure distillate may be drawn from the receiver and sprayed into

the top of the dephlegmator, so as to maintain, in connection with the cooling effect of the balance of the dephlegmator, an outlet temperature for the vapors leaving the top of the dephlegmator of about 560 degrees F. (Walker, pp. 2467-2468; Seguy, Qs. 60 to 66, pp. 2496 to 2500; Qs. 70 to 72, pp. 2500 to 2503; Q. 105, p. 2516; Wilson, Q. 4850b, p. 9097). This means that practically all of the vapors of oil which is liquid above 560 degrees F. at the operating pressure will be condensed in the dephlegmator. This condensate in normal running amounts to about 80 per cent. of the vapors which leave the reaction chamber. It is discharged from the bottom of the dephlegmator through a long, vertical pipe referred to as the reflux leg, which at its bottom discharges into the raw oil line adjacent its connection to the entrance end of the heating coil (Walker, pp. 2465a, 2469).

The raw oil is drawn from storage by a pump which forces the oil through the oil feed line under a pressure of about 185 pounds per square inch.

In most cases this oil is forced directly into the entrance end of the heating coil, or tubes. In some cases, however, this oil is passed into the top of the dephlegmator, where it will co-operate in the condensation of 5674 vapors therein and will in turn be preheated by these vapors. Thus there is a heat exchanging action. Instead of wasting all of the heat taken out of the vapors in the condensation thereof, a part of the heat is utilized for raising the temperature of the raw oil on its way to the heating tubes. In this operation both the reflux and the raw oil pass down the reflux leg and through the feed line into the lower end of the heating coil (Walker, p. 2470; Seguy, Qs. 70, 71, p. 2501).

In both operations, all of the reflux, without any cooling, enters the raw oil line and serves to materially raise the temperature of the raw oil, so that the oil entering the heating coil, which consists of a mixture of the raw oil and the reflux, is at a temperature of approximately 500 to 600 degrees F. (Seguy, Q. 49, pp. 2489, 2490).

This mixing of the large amount of reflux—about 80 per cent. of the vapors leaving the reaction chamber (Seguy, Qs. 102-104, p. 2514)—with its contained Heat, with the raw oil entering the heating tubes, and without mixing to any degree with the once treated, carbon-containing, dirty oil, is a feature of paramount importance in defendant's set-up. It is a feature of paramount

importance also in the plaintiff's Holmes-Manley stills, and in the industry is termed "clean circulation".

No argument is needed to convince one of the great saving which is effected by returning the great quantity of reflux—in amount approximately twice that of the raw feed—with its contained heat, which is in the neighborhood of 700 degrees F. (Seguy, Q. 47, p. 2488; Q. 49, p. 2489).

Thus assuming a plant treating a thousand barrels of oil per day, or 42,000 gallons, the reflux would amount to approximately 84,000 gallons and the saving effected by returning the reflux hot, as compared with a scheme such as that disclosed in the Adams process patent, wherein the return from the vapor trap mixes with the dirty oil and is returned therewith to the supply tank for recirculation through the system, and is necessarily cooled en route (indeed, in the Tulsa apparatus a cooler was provided for this material), would amount to the cost of raising 84,000 gallons of oil from approximately atmospheric temperature to 700 degrees F.

The vapors of the oil which boil below approximately 560 degrees F. at the pressure used pass from the top of the dephlegmator to a cold condenser, and the condensible portions thereof are liquified and discharged with the incondensible gas into a receiver. The pressure distillate recovered in the receiver is about 60 per cent. of the oil treated and about 60 per cent. of this boils in the gasoline range of today (Seguy, Q. 102, p. 2514).

(Defendant obtains no results comparable to those Adams asserted he obtained with expired patent No. 976,975. Deft. Ex. 8, p. 42.)

From the top of the receiver of defendant set-up a non-condensible gas line leads, having a regulatory valve located in it, and from the bottom of this receiver a liquid draw-off leads (Walker, pp. 2465, 2465a; Q. 464, p. 3549).

By properly setting the regulatory valve on the non-condensible gas line, the desired gas pressure may build up throughout the system, since the amount of incondensible gas which enters the receiver is greatly in excess of that required to saturate the distillate therein. This excess is due largely to the enormous quantity of condensation which takes place in the dephlegmator. This dephlegmator is not a cold condenser. That is, the lowest temperature obtained therein is about 560 degrees F. and the condensate formed therein is not cooled materially

below 700 degrees F., so that practically all the non-
condensible gas formed and freed by the high tem-
5675 perature to which the oil is subjected in the heating
tubes and reaction chamber is not absorbed again in the condensate formed in the dephlegmator, but passes overhead with the vapors of the low boiling oil to and through the cold condenser.

There the distillate becomes saturated with incondensible gas, but the quantity of such gas in respect to the liquid is then so great that there is a large surplusage of gas over and above that required to satuate the distillate. By retarding the flow of this excess gas from the receiver, the desired pressure, which in defendant's system is between 150 and 185 pounds, may be built up (Walker, Qs. 464, 465, pp. 3549, 3550).

An important feature, due to the described set-up is that the regulatory valve on the gas line is located in a cold part of the system, *i. e.*, beyond the cold condenser. When the regulatory valve is located between the converter and the condenser it is subjected to the very high temperature of the gas and vapors and its operation seriously impaired (Walker, Rec. 3550).

The "Clean circulation feature" of defendant's set-up forms the subject-matter of the claims of patent 1,392,629, Dubbs, granted October 4, 1921, to the defendant (Def. Ex. No. 185d).

* * * * * * *

In both the Holmes-Manley process and defendant's "clean circulation" is an outstanding characteristic and important feature. A heating coil several times as long as the height of the Washington Monument is another. Condensing under pressure and separating the uncondensible gas, while under pressure, from the distillate, is another. Continuation of the cracking reaction initiated in the heating coil, with concomitant precipitation of carbon and the accumulation thereof in a large reaction chamber, is another.

In connection with the importance of this last feature, which is not even suggested in the Adams patents, plaintiff's president, Holmes, testified as follows:

"Thus ideal conditions are maintained in the coil where greater heat is applied without substantial cracking, and the cracking effected in the stills where a cracking temperature is merely maintained." (Rec., Q. 59, p. 2779.)

The outstanding features of the Dubbs process and plaintiff's so-called Holmes-Manley process separate them from the Adams schemes by a chasm as vast as the Grand Canyon.

Minor Part of Cracking Occurs in Heating Coil of Defendant Set-Up.

The evidence is overwhelming that in respect to the amount of cracking which takes place in the long heating coils of the Holmes-Manley and Dubbs set-ups, and the amount which takes place in the reaction chambers, there is no substantial difference.

Plaintiff acquired this feature from Otto Behimer and it is now prosecuting a patent application of Behimer, No. 263,562, addressed thereto (Def. Ex. 36).

Defendant acquired the feature from C. P. Dubbs and it is disclosed in his application now involved in the United States Patent Office in an interference proceeding with said Behimer application for the purpose of determining the question of priority of invention (Def. Ex. 26, papers 34 and 44, pp. 163-190).

Plaintiff coined the slogan "Heating without cracking and cracking without heating," for graphically expressing the idea that practically no cracking occurred in the heating coil, but that practically all of it occurred in the reaction chamber.

5676 As a result of an actual run of defendant's apparatus, during September, 1923, which was fairly representative of the average operating conditions of that apparatus (X-Q. 253, Rec. 2561; X-Qs. 738-43, Rec. 3213-14), Mr. Seguy testified that he found that approximately 10% of the gasoline made in the plant was made in the heating coil (Q. 39, Rec. 2495).

His calculations were gone into very exhaustively during his cross-examination and as a result thereof it appeared that only about 4% or 5% of the gasoline made in the plant is formed in the heating coil (X-Q. 621, Rec. 2984).

The figure 10% first given by Mr. Seguy, was intended to take care of any possible errors and as it later turned out was unduly favorable to plaintiff.

* * * * * *

Now contrasted with the operation which occurs in defendant's practice wherein there is a very small amount of

cracking in liquid phase in the long heating tubes, in comparison with that which takes place in the reaction chamber —so small that a scraper is not required—we have the Adams operation, where all, or practically all, of the cracking takes place in vapor phase in the short tube 12, and something in the nature of an Archimedes screw scraper is essential.

As stated, in the defendant's set-up practically all of the cracking takes place in the large reaction zone where the carbon, amounting to ten or fifteen tons, may accumulate during the run.

A Graphic Comparison of the Essential Features of Adams' Apparatus and Process With Defendant's Apparatus and Process.

In order that the Court may have graphically before it, so that a comparison can readily be made, the essential features of the Adams inventions and defendant's process and apparatus we give herewith comparative summations in tabulated forms.

Comparative Set-Up Fig. 1—Apparatus With Defendant Device.

Adams' Apparatuses.	*Defendant's Device.*
	(1) The oil to be treated is pumped under a pressure of 185 pounds from a suitable supply into the system.
	(2) The oil is forced into a horizontally arranged heated coil, in length 4,500 times its diameter.
	(3) The coil is universally heated from end to end thereof by placing it in a furnace.
	(4) The bore of the heating tube is unrestricted from end to end thereof. The oil flows therethrough as a solid body.

5677 *Adams' Apparatuses.* *Defendant's Device:*

(5) By heating the coil itself the oil temperature is elevated to that which was common in cracking operations, this temperature being well below the temperatures which had been used in commercial cracking carried out in tar stills.

(6) In the defendant's apparatus, the oil and such vapors as may be formed in the passage of the oil therethrough, flows through the tube at a high speed—reaching about 10 feet per second—and the entire content of this heating tube is discharged into the top of a reaction chamber located remote from the cracking tube, and entirely out of the zone of any possible fire which might occur in connection with the heating tube. The reaction chamber is in diameter approximately thirty times that of the diameter of the heating coil. During a run, practically all the carbon formed is precipitated from the oil and accumulates therein, and amounts to from 10 to 15 tons. Continuously throughout the run, the dirty, carbon-carrying oil is withdrawn from the lower part of this chamber.

The cracking reaction initiated in the heating coil is completed in this chamber. The oil under treatment is in the heating coil for a

Adams' Apparatuses. *Defendant's Device.*

period of about five minutes, and in the reaction chamber for upwardly of an hour.

(7) In defendant's set-up, there is no part associated with the end of the heating tube, into which the oil to be treated enters for receiving heavy bottoms. The reaction chamber into which the oil discharges receives the carbon, or coke, which accumulates therein, amounting from 10 to 15 tons, until the end of a run. The heavy once treated oil, however, continuously flows out of the bottom of this reaction chamber and is not again used in the system.

5678

(8) In defendant's apparatus the oil is discharged as vapors from the heating coil never percolates through the liquid in the reaction chamber. All of these vapors, with such vapors as may leave the oil in the lower part of the reaction chamber, pass to a dephlegmator located in the vapor line leading to the cold condenser. In this dephlegmator, about 80 per cent. of the vapors which leave the reaction chamber are condensed to a liquid and returned to the entrance end of the heating coil.

In defendant's operation the condensation which occurs in the dephlegmator is of a very large part of the

Adams' Apparatuses.	*Defendant's Device.*
	oil fractions resulting from the cracking reaction. The distillate discharged from the cold condenser is not re-run through the system again. There is no proof that liquid oil is ever entrained in the vapors and carried into the dephlegmator. (9) In defendant's operation due to the large condensation which takes place intermediate the reaction chamber and the cold condenser, there is a large surplusage of incondensible gas, and this is discharged from the system through a line leading from the top of the distillate receiver. In this line is a regulatory valve and by restricting it, the gas can be backed up in the system and is backed up to give a substantially uniform pressure throughout the system, in excess of 150 pounds to the square inch.

Next Comparing the Set-Up of Fig 2 of the Adams Patent With Defendant's We Find as Follows:

Adams'.	*Defendant's.*
5679.	(1) Defendant's apparatus, as pointed out, lacks all of the characteristics of the Adams converter, and the oil is heated to a much lower temperature, and cracking is carried on in liquid phase, rather than in vapor phase, as is Adams, and under a super-atmos-

Adams'. *Defendant's.*

pheric pressure upwards of 150 pounds.

(2) In contradistinction to this cyclic batch system, which involves the re-circulation through the converter of once treated, dirty, carbon-carrying oil, defendant's apparatus is a truly continuous once-through system, in which the dirty carbon carrying oil is continuously withdrawn from the system through the discharge from the reaction chamber, and is never used again, or never re-circulated.

(3) Defendant's set-up as stated, has a dephlegmator arranged in the vapor line for condensing about 80 per cent. of the vapors which leave the hot part of the system and pass towards the cold condenser; these vapors in large part being of converted oil.

Defendant's set-up does not embody any part in the nature of an expansion tank 125, which, as stated, in the Adams apparatus is located between the first hot oil tank 128 and the vapor dome.

An expansion tank presupposes a radically different pressure condition between that obtaining within the same and that obtaining outside of the entrance thereof. In the Adams set-up, this different condition is obtained through the spring-

seated valve 124 controlling the entrance to the expansion tank 125. Thus the pressure in the passage normally closed by this valve is higher than that on the other side of the valve in the tank 125. Nothing of this sort is in defendant's set-up.

5680 B. Comparison of Essential Steps of Adams' Process With Defendant's Process.

Defendant's Process.

(1) Defendant's is a continuous once through system.

The oil is forced by a pump through a long heating coil, 4,590 times its diameter, and the entire contents thereof discharged into a large reaction chamber, 30 times greater in diameter than the coil, from the lower part of which the treated, dirty, carbon-containing oil continuously passes from the system.

Dirty oil is never returned to the heating zone or circulated therethrough.

* * * * * *

(10) The oil in the reaction chamber cannot impose any pressure upon the oil in the heating coil. It has no effect whatsoever upon the heating coil or oil or vapors therein.

(11) Practically all of the carbon formed during a run is precipitated and accumulated in the reaction

Defendant's Process.

chamber—this amounting to from ten to fifteen tons—and is removed after each run.

(12) Under normal operations the oil in defendant's procedure is heated to approximately 850 d. F.

On exceptional occasions, it has gone momentarily as high as 890 d. F. This is below its critical temperature.

The appearance of a red spot or red tube, in defendant's operation is a danger signal, and unless by checking the fires, or otherwise, it can be made to disappear, the plant is shut down.

(13) Cracking is substantially in the liquid phase, since the temperature is used is well below the critical temperature of the oil undergoing treatment, and the pressure employed is sufficient for holding the oil, or the greater part of it in a liquid phase at the temperature used.

5681 A further outstanding feature wherein Dubbs is radically different from Adams is that the cracking is so light in Dubbs' heating coil that, notwithstanding no carbon scraper is used, there is therein no material carbon accumulation.

Most of the cracking is done in the large reaction chamber, in diameter thirty times that of the coil, where, in the course of a run, as much as 15 tons of carbon accumulates notwithstanding treated oil—residuum oil—is being constantly withdrawn.

It is hardly necessary to point out that defendant's heating tube, which is 1500 feet long and uniformly heated externally from end to end, and wherein but a small amount of the cracking occurs, and which is unrestricted from end to end, by no possibility could be considered the equivalent of the retort restricted by the internal electrical heater nor does it exhibit the feature of "locally" applying heat to a restricted body of oil.

A further radical distinction between Adams and Dubbs is that in any event, the former does the major portion of the cracking in the part he calls the cracking chamber—the tube 12. On the contrary, Dubbs employs the incipient conversion principle; that is the oil is passed with great rapidity through a heating coil, where it is raised to a temperature of approximately 850 dg. F. and during this period only a minimum amount of cracking occurs, because the oil is at a cracking temperature in the coil only for a minute or two, and then the entire contents of the coil is discharged into the top of the remotely located reaction chamber, where it remains for a considerable period of time—a matter of an hour—and where the cracking reaction, initiated in the heating coil, is completed.

We have just discussed this matter of temperature and have endeavored to show that there is such a radical difference between the temperature contemplated by Adams and that employed by defendant that not only are the two radically different per se, but they involve radically different principles of operation; one, in fact, spelling a vapor phase, low pressure operation, and the other (defendant's) is actually a liquid phase operation carried on at a pressure below 150 and 180 pounds per square inch.

As Adams clearly states in his patent, he uses either a sub-atmospheric pressure or one not in excess of 10 pounds, because he was afraid of an explosion if he operated under a substantial super-atmospheric pressure (pat., p. 4, lines 52-56, 77).

(2) There is no dispute that this process discloses a vapor phase cracking process (as contradistinguished from defendant's and also plaintiff's commercial processes which are so-called liquid phase processes).

7. Pielsticker Patent No. 477,153, Defendant's Exhibit 181.

Through a controlling and anticipatory item, the patent was not cited against either of the Adams applications in the Patent Office.

The Court of Appeals in the Skelly case held it disclosed a cracking process of the "once through" type. In this respect it is similar to the defendant's operation, 5682 since in both cases no residual oil recirculates through the coil.

A 200 foot heating coil is provided discharging into an enlarged reaction chamber L.

Oil is continuously fed to the heating coil while residuum is continuously removed from the retort L and isolated from the system (p. 1, lines 18 to 22, and p. 2, lines 61 to 67).

Cracked vapors from chamber L are subjected to reflux condensation in the dome R and the condensate from this dome returns either to retort L or the supply tank A containing a bulk supply of oil like Adams and from which chamber the charging oil and reflux return for recracking (p. 2, lines 68 to 74).

The Pielsticker condensing dome R is a far more adequate and effective condenser than the vapor traps disclosed by Adams. Vapors are described as condensing therein, the condensate returned and reduced in gravity or otherwise stated, recracked (p. 2, lines 76 to 83).

Either a uniform atmospheric pressure may extend through the entire system, including the final condenser, or a superatmospheric pressure may prevail in the system to and through the reflux condenser R by setting the valve *b*. For severe and drastic cracking, the superatmospheric pressure prevails producing still lighter gravity oils than are obtained in the atmospheric pressure operation (p. 2, lines 106 to 111).

Cracking heat is imparted to the oil passing through the long coil D. The high velocity of the oil sweeps carbon out of the coil in suspension in the oil stream. This velocity prevents carbon formed in the coil from settling therein (p. 2, lines 16 to 30).

The excessive quantity of carbon formed in the coil D is the result of cracking of the oil therein. Carbon only forms when cracking occurs.

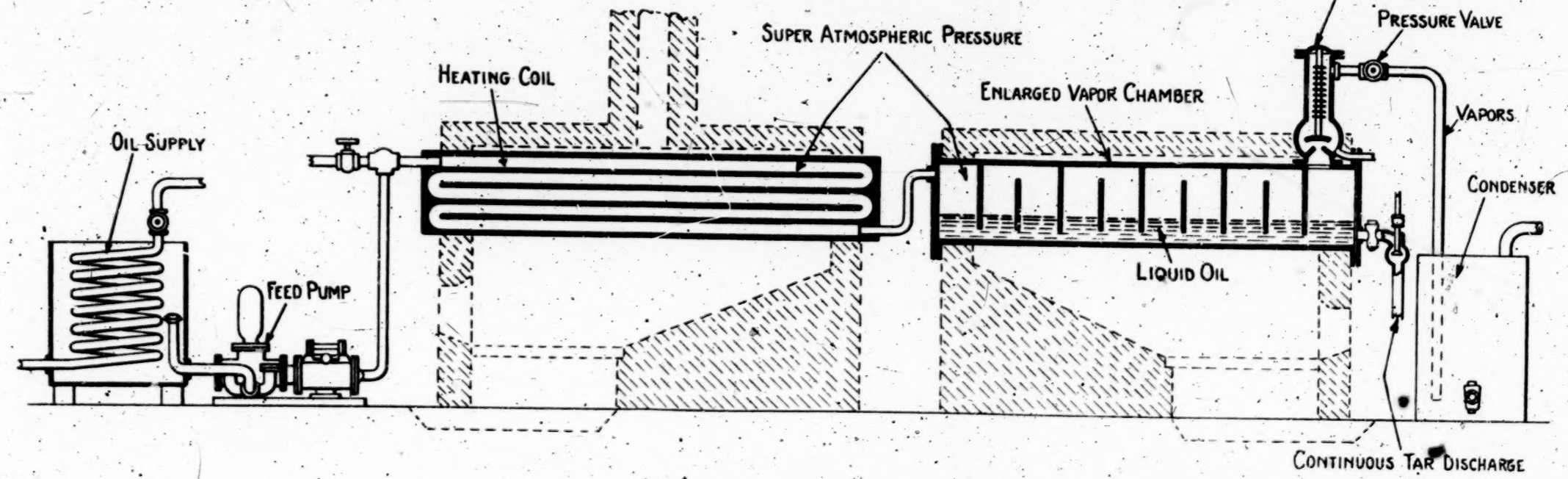
Plaintiff's expert Wilson testified that there is no trace of coke or carbon when cracking to make as high as 15 or 20 per cent. gasoline (X-Q. 4841, p. 9060).

In the Burton operation he asserted that 25 per cent. gasoline would be made before enough coke is formed to find it in a still (Q. 4836, p. 9058).

Plaintiff may suggest that the carbon repeatedly referred to in the patents is in fact a deposit of some other material. This view would contradict the plain statements of the patent that carbon is formed in the heating tubes and make unnecessary the use of the highly developed Pielsticker apparatus intended to overcome the carbon menace. The patent refers to carbon formed in the coil and it must be assumed that the skilled patentee had in mind carbon and not some other material that plaintiff may suggest. Such a view, if entertained, would permit the disclosure of any prior art item to be completely nullified by speculative suggestions.

3015

DX 827 B


Partial Condenser
Pressure Valve
Super Atmospheric Pressure
Heating Coil
Enlarged Vapor Chamber
Vapors
Oil Supply
Condenser
Feed Pump
Liquid Oil
Continuous Tar Discharge

5684 **DX 828.**

IN THE DISTRICT COURT OF THE UNITED STATES

For the Northern District of Illinois,

Eastern Division.

Carbon P. Dubbs, *Plaintiff,*
vs.
Universal Oil Products Company, a corporation, *Defendant.*
} In Equity No. 7184.

INTERROGATORIES TO BE ANSWERED BY THE DEFENDANT AND BY H. J. HALLE, PRESIDENT, ROBERT J. DUNHAM, EXECUTIVE VICE PRESIDENT AND B. T. LENSKE, AUDITOR OF THE DEFENDANT, OR SUCH OF SAID OFFICIALS OF THE DEFENDANT AS THE COURT MAY DIRECT.

1. Set forth the forms of the license agreements under which the defendant has granted to other individuals or corporations the right to manufacture or sell products covered by patents, the interest in which was obtained either in whole or in part by assignment from the plaintiff to the defendant under the contract of October 25, 1919, attached to the bill herein, omitting descriptions of patents, names of the licensees, dates, signatures and amounts.

5690 IN THE DISTRICT COURT OF THE UNITED STATES,

For the Northern District of Illinois,

Eastern Division.

Carbon P. Dubbs,
Plaintiff,
vs.
Universal Oil Products Company, a corporation,
Defendant.
} In Equity No. 7184.

ANSWERS OF H. J. HALLE, PRESIDENT, ROBERT J. DUNHAM, EXECUTIVE VICE PRESIDENT; AND B. G. LENSKE, AUDITOR OF THE DEFENDANT, TO THE INTERROGATORIES FILED IN SAID CAUSE BY THE PLAINTIFF.

Answer to Interrogatory 1:

No license has even been granted by the defendant for the use only of the patents, inventions, processes or apparatus acquired in whole or in part by assignment from the plaintiff under the contract of October 25, 1919. On the contrary, licenses have, in every instance, granted the right to the licensee to use all patents, inventions, processes and apparatus for cracking petroleum oils and useful in connection therewith, then owned or thereafter granted to or acquired by the defendant. These patents and inventions include a substantial number not acquired either in whole or in part from the plaintiff under the contract of October 25, 1919, or pursuant thereto, among that number being the patents originally acquired from Jesse A. Dubbs, long prior to said contract, and constituting the origin and basis of the defendant's licensing system. Hence,
5691 answers to Interrogatories 1 to 4, inclusive, must, and do, cover all licenses granted by the defendant. A copy of the printed form of license agreement now in use by the defendant is attached as "Exhibit A". All licenses outstanding are substantially identical with respect to rights granted, differing only in the listing of the defendant's patents and patent applications, which has grown with the issuance of additional patents to the defendant

from time to time and with the acquisition of patents and patent applications by the defendant.

5700

H. J. Halle,
Prest.
Robert J. Dunham,
Executive Vice Pres't.
B. G. Lenske,
Auditor.

State of Illinois } ss.
County of Cook. }

H. J. Halle, Robert J. Dunham and B. G. Lenske, being first duly sworn on oath, depose and say that the foregoing answers to interrogatories by them respectively subscribed, are true and correct, to the best of their knowledge and belief.

H. J. Halle,
Robert J. Dunham,
B. G. Lenske.

Subscribed and Sworn to before me this 3 day of May, A. D. 1928.

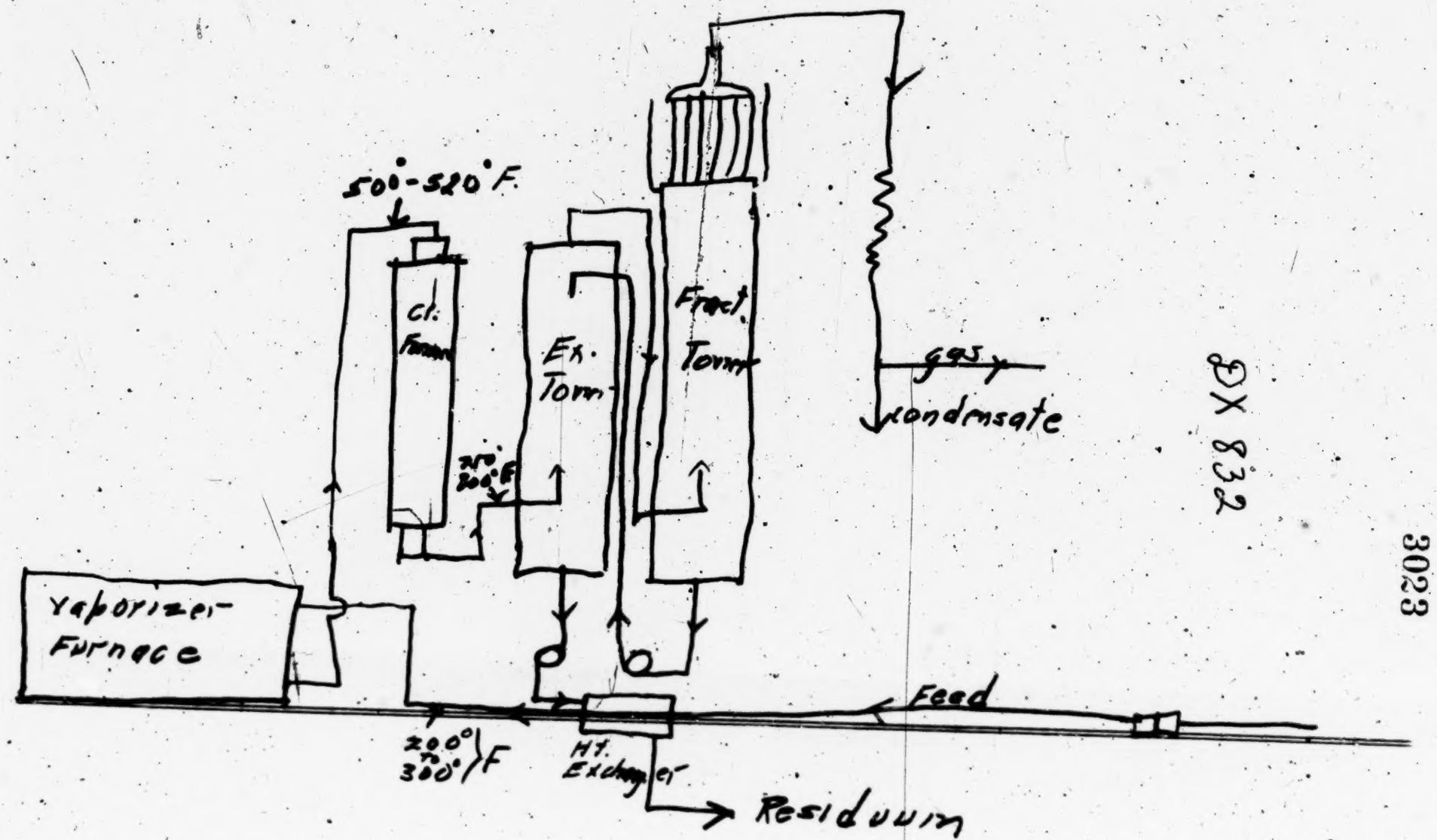
Paul J. Mueller,
Notary Public.

My Commission Expires 8-27-32.

DX 831 .21

9
Vent
8
Dethanizer
Fractionating Tower
10
1
15
11
To storage
Exch. Tower
6
7
2
5
Ht. exchanger
4
Feed
3

① Regular Operation Sel 4637

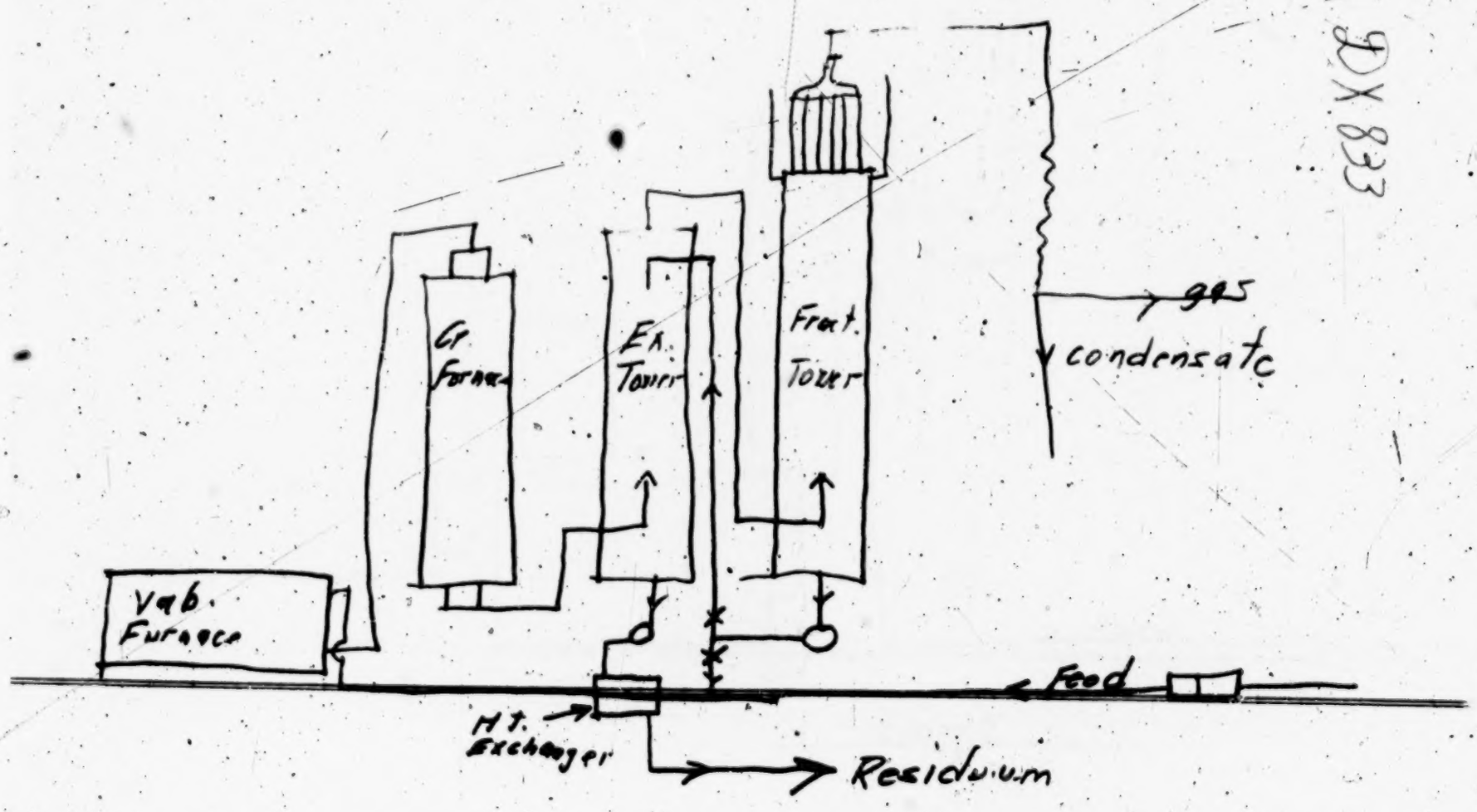


DX 832

3023

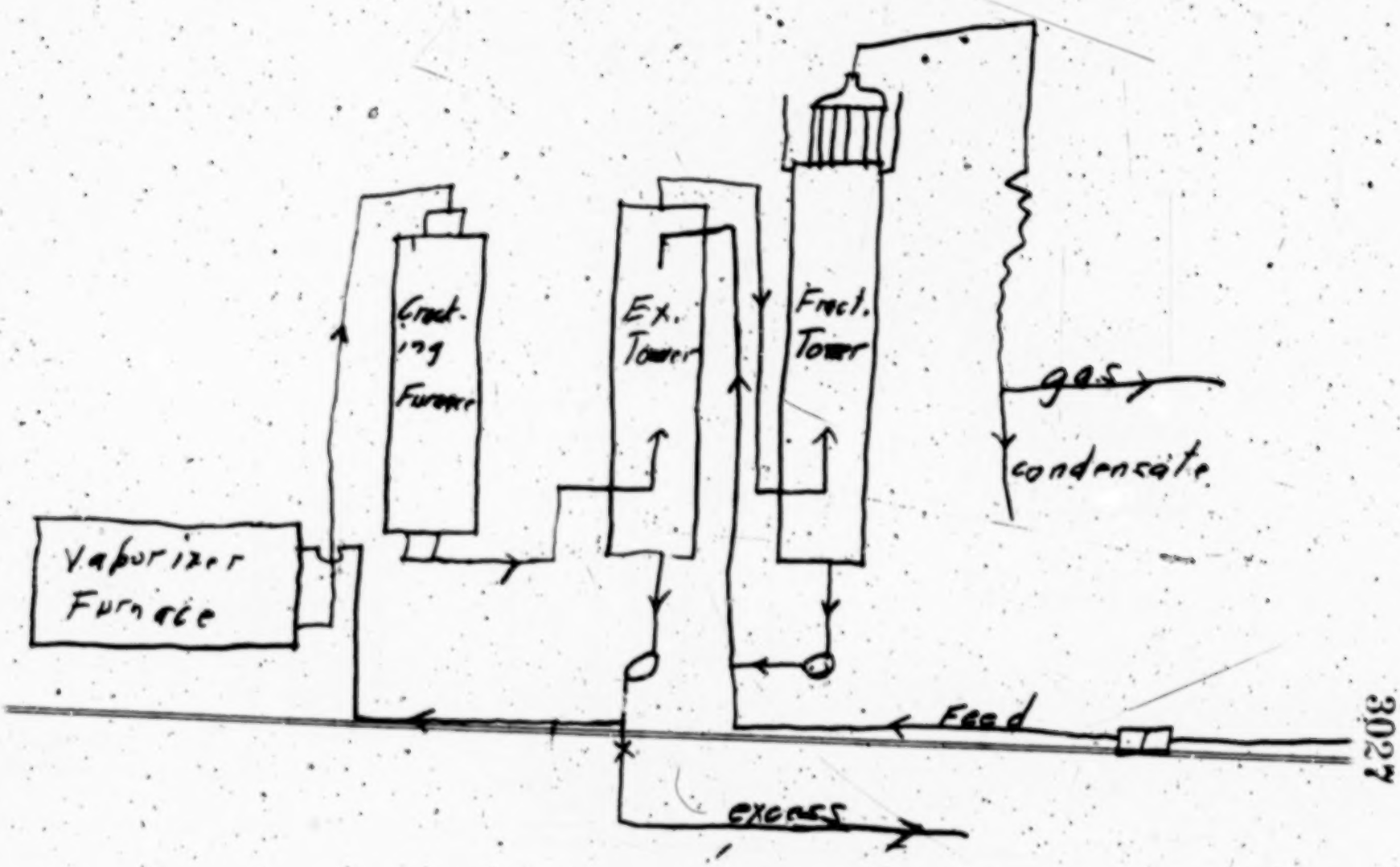
(2)

Return of Part of Condensate from Fractionating Tower with fresh feed.



DX 833

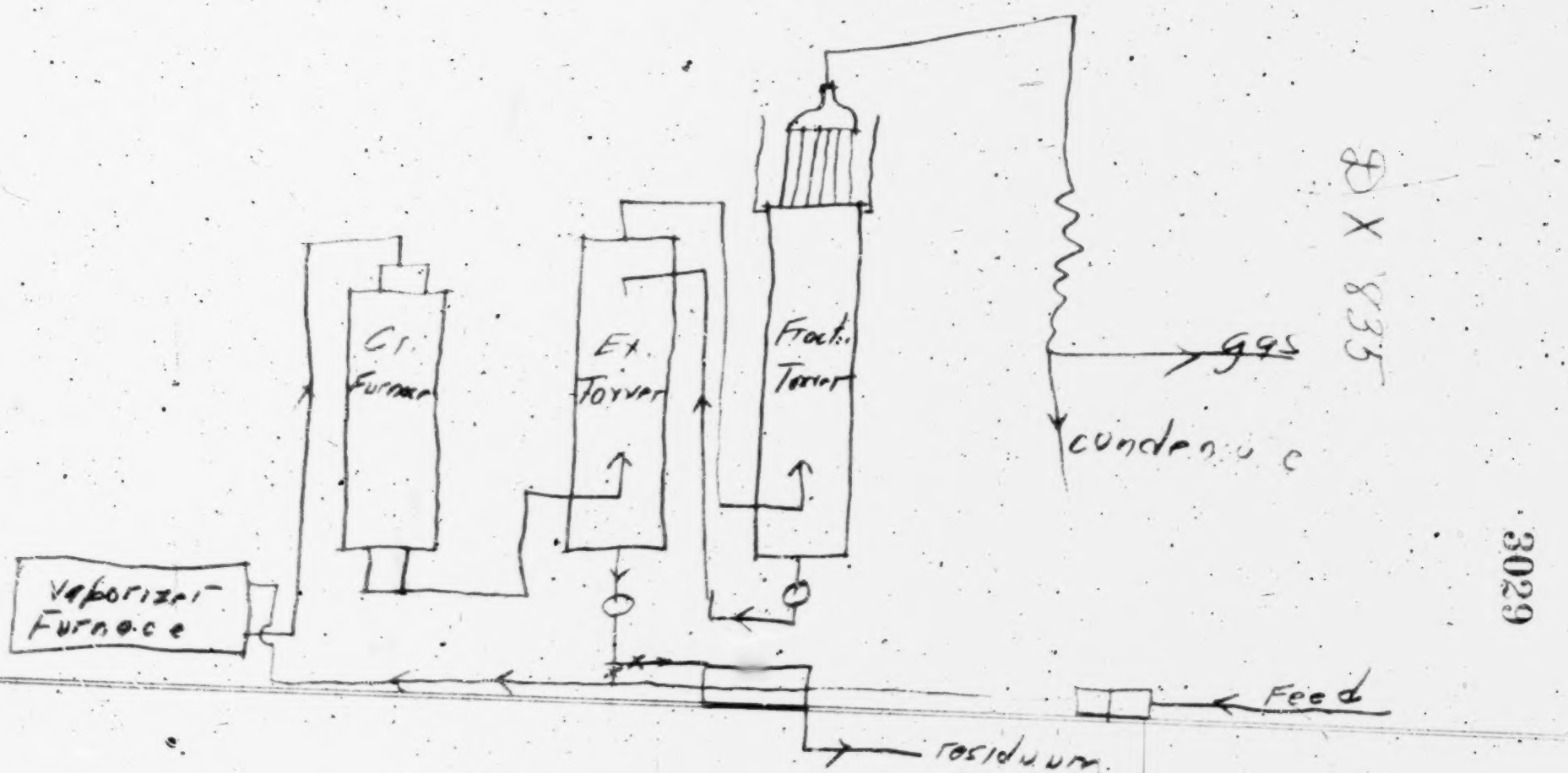
3025.


Vaporizer Furnace
Cracking Furnace
Ex. Tower
Fract. Tower
gas
condensate
Feed
excess

3027

④

Return of part of Condensate from Exchanger Tower with fresh stock



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3029

SUMMARY OF DEMONSTRATION RUNS ON DUBBS UNIT AT AVON, CALIFORNIA - MADE FOR STANDARD OIL CO. OF CALIF. - 1924-1925

Run Number	1	2	3	4	5	6	10	11	12	13	14	15	16	17	18	19	20	21
Type of Operation	Residuum	Residuum	Residuum	Residuum	Residuum	Residuum	Residuum	Residuum	Residuum	Residuum	Residuum	Residuum	Residuum	Residuum	Residuum	Residuum	Residuum (2 Chambers)	Residuum (2 Chambers)
Charging Stock																		
Type		California Gas Oil					Heavy Gas Oil (Vacuum Distilled)			California Gas Oil		Southern California Heavy Gas Oil		California Gas Oil		Fuel Oil	Southern Calif. Heavy Gas Oil	Fuel
API Gravity	26	26	25.5	25.5	26	25.9	26.0	25.9	25.9	26.0	26.0	25.6	25.6	26.3	26.3	17.7	25.5	17.7
Gals Per Hour Charged	1433	1274	1203	1171	998	993	1043	1046	1138	1096	1053	1207	1161	1170	1235	1244	1257	1173
Bbls/Day On Stream (42 Gals Per Bbl)	811	724	814	669	573	567	681	597	667	625	602	688	663	667	709	712	718	682
Pressure Distillate																		
Gals / Hr	917	864	776	787	618	704	665	708	798	773	681	829	761	735	756	693	824	619
% Of Charging Stock	64.13	67.7	53.5	53.8	61.9	72.4	72.5	67.7	70.16	70.54	64.66	68.69	65.56	62.86	61.20	55.7	65.58	52.83
API Gravity	40.6	42.5	47.3	49.5	49.6	49.6	49.6	49.2	49.3	48.7	51.3	52.1	53.3	52.3	53.5	53.9	53.9	53.7
Dry Point	612	567	588	564	488	488	585	585	588	572	464	592	576	587	574	596	590	561
Gasoline (Based On Hempel Distillation)																		
% In Pressure Distillate	55.0 (410°F)	42.0 (410°F)	62. (410°F)	73. (410°F)	71.25 (410°F)	71.25 (410°F)	67.5 (410°F)	65.5 (410°F)	70.25 (410°F)	72.25 (410°F)	75.76 (410°F)	79.5 (403°F)	83.25 (423°F)	83 (423°F)	83.33 (423°F)	81 (423°F)	84.23 (433°F)	80 (42
% Based On Charging Stock	35.36 (410°F)	27.0 (410°F)	38.4 (410°F)	46.6 (410°F)	49.10 (410°F)	52 (410°F)	49 (410°F)	44.4 (410°F)	49.29 (410°F)	50.97 (410°F)	58.39 (410°F)	54.58 (433°F)	54.24 (423°F)	52.14 (423°F)	51. (423°F)	41.9 (423°F)	55.3 (433°F)	41.46 (42
Residuum																		
Gals / Hr.	450	410	414	416	287	184	218	269	114	89	202	257	218	297	336	498	227	415
% Of Charging Stock	31.41	32.37	34.4	35.5	28.7	18.3	23.	25.01	8.15	19.16	20.8	18.8	25.83	27.2	40	12.14	35.13	
API Gravity	16.0	11	13 (approx)	10	7.8	11.3	16.3	11.8	6.4	17.2	5.8	7.	7.5	7.	8.7	8.7	9.3	9.4
% B S & M	—	—	—	—	—	48	—	41.	85.	—	10.	11.	12.5	8.	—	42.	—	—
Coke																		
Lbs In Tubes	Still Not	184	—	159½	132½	108	55.5	88	274	285	185	15	393½	16	About 3	128	(Not Weighed Very Little	210½
Lbs In Reaction Chamber	Cleaned	30,508	—	24,391	44,490	32,765	41,850	22,037	48,171	38,304	40,569	41,850	37,536	28,314	7,650	24,000	65,285	67,272
Uncondensable Gas - Loss & Carbon																		
% Of Charging Stock	4.35	6.68	22.30	9.2	10.4	13.4	9.2	9.3	14.83	21.31	16.18	16.51	15.64	11.81	11.6	8.3	17.28	3.06
Operating Conditions																		
Hours On Stream	17⅓	35⅝	4⅝	66½	70⅝	51⅛	47	47	43⅝	34	57¾	46	48	44½	20½	30¾	71¾	77¾
Hours Off Stream Between Runs	59	43½	36⅛	38	31	—	73	23¾	3⅛	47¼	37½	37⅛	24½	15½	25⅛	45⅝	(41 Days)	39
Operating Pressure	150-175	175-190	—	175	175	175	150	190	175	200	200	200	200	200	200	150	200	150
Temperatures																		
Transfer Line °F	553	831	—	858	864	863	857	854	876	878	868	870	865	860	855	838	866	866
Vapors To Dephl °F	763	612	—	810	816	801	810	800	824	831	821	827	814	809	804	813	867	811
Combined Feed °F	733	759	—	751	746	742	746	737	757	776	761	761	753	752	743	743	750	729
Vapors To Condenser °F	556	532	—	516	532	530	510	526	529	528	518	519	495	491	496	476	453	476
Furnace Flue Gases - Above Tubes °F	1460	1540	—	1507	1552	1544	1585	1563	1610	1606	1586	1643	1614	1617	1487	1461	1467	1454
Furnace Flue Gases - Below Tubes °F	893	961	—	968	967	955	995	930	985	1015	992	994	983	985	989	983	968	995
Remarks - Reason For Shutdown	Leaky Pin at Hot Oil Pump	Leak at Thermocouple	Leaky Thermocouple	- Normal Shutdowns -											Hot Oil Pump Stopped			

Note: All % Are By Volume.

The Records Do Not Give Reasons For The Elapsed Between Runs.

DX 849

DATE, JUNE 20 1926

OF DEMONSTRATION RUNS ON ...NIA - MADE FOR STANDARD OIL CO. OF CALIF. - 1924-1925

14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
...DUUM	RESIDUUM	RESIDUUM	RESIDUUM	RESIDUUM	RESIDUUM	RESIDUUM (2 CHAMBERS)	RESIDUUM (1 CHAMBER)	RESIDUUM	RESIDUUM	RESIDUUM	RESIDUUM	RESIDUUM	RESIDUUM NON-RESIDUUM	NON-RESIDUUM	NON-RESIDUUM	NON-RESIDUUM
OIL	SOUTHERN CALIFORNIA HEAVY GAS OIL	CALIFORNIA GAS OIL	FUEL OIL			SOUTHERN CALIF HEAVY GAS OIL	FUEL OIL	SOUTHERN CALIF HEAVY GAS OIL	FUEL OIL				SOUTHERN CALIF GAS OIL	FUEL OIL		
26.0	25.6	25.6	26.3	26.3	17.7	25.5	17.7	17.7	25.5	17.7	17.7	17.7	17.7	20	17.7	17.7
053	1207	1161	1170	1235	1244	1257	1173	1052	1100	1246	997	967	977	1005	1101	1120
602	688	663	667	709	712	718	682	618	635	711	626	613	674	573	632	648
681	829	761	735	756	693	824	619	708	851	792	589	739	611	962	757	750
64.66	68.69	65.56	62.86	61.20	51.7	66.58	54.83	65.5	74.23	63.6	53.76	68.7	51.17	76.5	68.74	54.36
51.3	52.1	53.3	52.3	53.5	53.9	53.9	53.7	51.7	49.	51.2	52.9	49.5	53.2	47.1	46.8	48.3
464	492	476	487	479	496	490	460	498	526	517	497	533	449	532	544	554
15.76 (419°F)	19.5 (403°F)	53.25 (423°F)	53 (423°F)	52.33 (423°F)	81 (423°F)	84.23 (433°F)	50 (420°F)	77.66 (420°F)	70.33 (420°F)	73.66 (420°F)	78.66 (430°F)	70 (430°F)	53 (402°F)	64.5 (410°F)	66 (421°F)	66.5 (420°F)
48.98 (410°F)	54.58 (423°F)	54.24 (420°F)	52.19 (423°F)	61. (403°F)	49 (423°F)	55.3 (433°F)	41.46 (420°F)	50.66 (420°F)	52.23 (420°F)	46.5 (420°F)	42.29 (419°F)	48.09 (420°F)	41.51 (422°F)	53 (410°F)	46.39 (421°F)	44.65 (420°F)
202	251	218	287	336	498	227	419	121	64	127	296	156	391	NONE	NONE	NONE
19.16	20.8	18.8	25.83	27.2	40	17.14	35.13	11.2	5.61	14.2	27.02	14.6	33.1	NONE	NONE	NONE
5.8	7.	7.5	7	8.7	8.7	9.3	9.4	—	—	—	8.	—	5.1	—	—	—
10.	12.	12.5	8	—	4.2	—	—	—	—	—	—	—	—	—	—	—
185	15	393½	16	ABOUT 3	128	(NOT WEIGHED VERY LITTLE)	210½	162	125½	214	217	131½	225	64	—	130½
569	41,850	37,536	28,314	7,650	24,000	65,295	67,272	46,224	40,950	32,370	33,325	40,192	31,510	197	—	32,528
16.18	10.51	15.64	11.81	11.6	83	17.28	13.04	23.3	20.16	16.00	19.22	16.7	14.92	25.10	31.26	33.64
59¾	46	48	46½	20½	30¾	71⅛	77¾	23¼	32	17½	39¼	20¾	58¼	35¾	20¾	20
37½	37½	24½	15½	25¾	45⅝	(41 DAYS)	39	41¼	43½	28¾	25¾	40¾	21¾	10⅝	28½	—
200	200	200	200	200	150	200	150	150	160	160	160	160	160	160	160	160
868	870	865	860	855	853	866	866	859	865	883	870	859	867	851	894	892
821	827	814	809	804	813	807	811	853	832	814	823	825	808	822	819	817
761	761	753	752	743	743	750	729	749	757	740	741	748	734	761	743	734
518	509	495	491	496	476	983	976	493	617	505	483	512	475	524	520	519
586	1443	1474	1477	1487	1461	1467	1454	1501	1513	1445	1443	1341	1369	1461	1363	1353
998	994	983	985	789	988	968	995	1010	1009	982	975	979	961	1005	964	958
				HOT OIL PUMP STOPPED					NORMAL SHUTDOWNS							

5718 DX 850.

Summary of Convertor Logs

Hall Unit — Bayonne, N. J.
Run 24 — January 22 to February 5, 1917

	Convertor Temperature Within Coil at Outlet (a)		Convertor Pressure at Coil Inlet (b)	Dephlegmator Pressure	Feed Rate		Dephlegmator Temperature Last Tower (a)		Total Feed During Run by Meter
	°C	°F.	Lb. per sq.in. gauge	Lb. per sq.in. gauge	Gallons per 30 min.	Gallons per min.	°C	°F	Gal.
Convertor No. 1	610	1130	101	4.8	92.9	3.10	116	241	62351.2
Convertor No. 2	608	1126	95	4	92.7	3.09	132	270	62626.9
Convertor No. 3	610	1130	105	4.5	92.5	3.08	129	264	62148.4
Convertor No. 4	611	1132	101	3	93.2	3.11	133	271	62978.8

(a) DeFlorez—Record: p. 2592
(b) DeFlorez—Record: p. 2604

5719 MOTION OF DEFENDANT FOR RE-ADMITTING INTO EVIDENCE, DX 816 (for identification), filed June 24, 1940:

5720 Defendant moves that Dubbs file-wrapper Serial No. 208,206, now marked for identification as Defendant's Exhibit 816, be admitted in evidence in the above-entitled cause and for ground of its motion states:

During the testimony of plaintiff's rebuttal witness, George Granger Brown, plaintiff offered in evidence as Plaintiff's Exhibit 841, certain parts of the abandoned Dubbs file-wrapper No. 144,979, filed January 27, 1917.

During the course of his testimony regarding said exhibit, Dr. Brown quoted therefrom a passage relating to the transfer of "oil and generated vapor" from the coils to the drums.

The purpose of the offer of said Dubbs application No. 144,979 was stated by plaintiff to be that of carrying the date of the Dubbs patent in suit back to the filing date of said application No. 144,979 on the ground that this abandoned application contained the disclosure of the patent in suit.

During the course of Interference No. 49,355, between

Dubbs and Behimer (Defendant's Exhibit 178), the
5721 Universal Oil Products Company made a motion to
shift the burden of proof (Defendant's Exhibit 178, page 45), Ground 2 of which was as follows:

"(2) For that the invention defined by the issue of the above interference is disclosed in each and every of the pending applications for patent of C. P. Dubbs as follows: application filed January 27, 1917, serial number 144,979, renewed December 14, 1921, serial number 522,397; for a method and apparatus for treating petroleum; application filed October 20, 1922, serial number 595,743, as a continuation of application serial number 208,206, filed December 21, 1917, for a method of treating hydrocarbon oils; application filed September 3, 1918, Serial number 252,301, for a process and apparatus for treating hydrocarbon; and application filed November 4, 1918, serial number 260,957, for a process and apparatus for producing low boiling point hydrocarbons."

The issue of the Interference was the claims, save claim 6, of the Dubbs patent in suit.

The Motion, as quoted above, shows that Dubbs contended that the disclosure of the '629 patent in suit was contained in a number of Dubbs applications, including Serial No. 144,979, admitted in evidence in the case at bar as Plaintiff's Exhibit 841, and Dubbs application, Serial No. 208,206 (Defendant's Exhibit 816 for identification).

In support of the Motion, there was filed an affidavit of Carbon P. Dubbs (Defendant's Exhibit 178, page 30), in which Dubbs stated (Defendant's Exhibit 178, page 31):

"* * * that affiant met Frank L. Belknap in Kansas City on or about the 25th day of October, 1923, and was present at Kansas City with the said Belknap during the remainder of that week and during this period the said Belknap called to his attention his applications for patent serially numbered 144,959 [144,979] filed January 27th, 1917 renewed as 522,397; 208,206 filed December 21st, 1917 and 260,957 filed November 4th, 1918, and asked him why he had not referred to the same or to the work done by him on the inventions disclosed therein, in the conferences
which were had for the purpose of preparing the
5722 prelimnary statement which was filed in this case.

* * * * * *

"Affiant now believes and asserts the fact to be that each of said applications last enumerated fully and com-

pletely disclose the subject matter of the present interference . . . ."

Dubbs application, Serial No. 208,206 (Defendant's Exhibit 816 for identification) which Dubbs in his affidavit (sworn to on November 2, 1923) asserted to contain the disclosure of the subject-matter of Interference No. 49,355, which subject-matter was the claims of the Dubbs '629 patent in suit, clearly discloses Dubbs' understanding of the meaning of the word "vaporization" in a coil and drum process, and in view of this fact and under the doctrine of *Weber Electric Company* v. *Freeman Electric Company*, 256 U. S. 668, and in view of the fact that Dubbs application, Serial No. 144,979 has been received in evidence by the Court and has been referred to by plaintiff's witness as containing a reference to "oil and generated vapors" in the coils, it is submitted that Dubbs application Serial No. 208,206, which was also relied on by plaintiff as containing the same disclosure as the patent in suit, should likewise be received in evidence for the purpose of confirming the use by Dubbs in the patent in suit of the word "vaporization" to denote the conversion or generation of vapor from liquid.

Thiess, Olson and Mecklenburger,
Attorneys for Defendant.

5723 OPINION OF THE DISTRICT COURT, filed July 24, 1941: Filed July 24, 1941.

5724 Plaintiff sues defendant charging infringement of two patents owned by it, one No. 1,392,629, granted to Carbon P. Dubbs, October 14, 1921, and assigned to plaintiff, and the other No. 1,537,593, granted to plaintiff May 12, 1925, upon the application of Gustav Egloff, each relating to a process of producing from heavier petroleum products a lighter oil capable of being used in internal combustion engines. Defendant says the patents are not valid, or if they are, it does not infringe.

Petroleum as it comes from the ground contains a variety of compounds composed of hydro carbon molecules, the various molecules being composed of atoms of hydrogren and carbon differently arranged and with differing numbers of carbon and hydrogen atoms. Many years ago it was discovered that by the application of heat some of these molecules could be broken up. Some of the heavier carbon atoms separated from lighter hydrogen atoms and

a lighter oil having a lower boiling point was produced. This process is known in the art as "cracking."

With the development and increased use of the internal combustion engine came a greatly increased demand for the lighter oil known as gasoline. This fluid was
5725 recoverable from crude petroleum by a simple process of distillation and this method had been used for years, but the amount so produced was insufficient to meet the needs of modern industry. It was known that gasoline could be produced from the heavier oils by cracking and various inventors had been exploring the possibilties of so producing gasoline in commercial quantities.

The first practical process, the first that met with commercial success, was devised by Dr. Burton and put into operation during the year 1912. In his process about 8250 gallons of a light oil which had theretofore been obtained from crude petroleum by distillation was put into a shell eight feet in diameter and thirty-two feet long. From that shell two vapor lines, each about 12 inches in diameter and 35 feet long led to a condenser. A fire was built under the shell and the liquid therein heated to a temperature of from 700° F. to 750° F., and became subject to autogenous pressure of about 75 pounds from the vapors and non-condensible gases produced by the heating. This temperature and pressure were maintained throughout the operation. The vapors generated passed up through the vapor tubes where they were subjected to partial condensation. The portion of the vapor condensed, termed reflux condensate, returned through the long vapor line to the shell where it was subjected to further cracking. The uncondensed vapor was passed on from the partial condensation chamber for further processing.

About twelve hours were required to bring the contents of the shell to the proper temperature and pressure, to bring the still "on stream". It remained "on stream" about 24 hours when it became necessary to draw the fires and withdraw the oil remaining in the still and remove the carbonaceous material which had been released during the operation and had adhered to the inner wall. This required about 12 hours.

This method had several disadvantages. A still could be "on stream" only about 24 out of every 48 hours.
5726 Only about 28% of the total charge was recoverable as gasoline. The "on stream" period was necessarily

limited to 24 hours because experience had shown that the carbonaceous material accumulating on the bottom of the shell retarded the absorption of the heat by the oil, and caused "hot spots" to appear on the shell. If the "on stream" period were extended an explosion was likely to occur at these "hot spots" with serious danger to the life of those operating the stil and great property damage as well. Several such explosions had occurred.

To overcome this danger of overheating a new process known as the Burton-Clark process was devised and put into operation about 1915. In this the heat is not applied directly to the shell. The oil is brought to a cracking temperature by passing through a nest of 4 inch. convection tubes which are placed within the furnace, the tubes being connected with the shell. While in the tubes the oil was heated to temperature of from 720° F. to 725° F. and subjected to pressure of 95 pounds. This temperature was maintained throughout the entire system. The overhead apparatus for handling the vapors, returning the reflux condensate and securing the pressure distillate was practically the same as for the Burton still and functioned in a like manner.

The cycle of operation of the Burton-Clark still was 72 hours, which included 15 hours necessary to bring the still up to pressure, thirty-six hours "on stream" and the remainder for shutting down, cleaning and getting the still ready for operation. The "on stream" period was limited to 36 hours for the same reason that the period was limited to 24 hours in the Burton process, coke accumulated where heat was applied to the tubes resulting in "hot spots." These were of frequent occurrance and caused buckling and often rupture of the tubes.

5727 This was the state of the art as practiced commercially when Dubbs appeared on the scene. The problem to be solved was to crack the heavier hydrocarbons to produce gasoline without coking up the vessel in which the cracking occurred. Dubbs solved the problem.

Dubbs states in the patent granted to him that one of his objects is to provide a cracking process "in which the carbon containing residue is continuously removed from the cracking zone while the reflux condensate is returned to the cracking zone for further treatment substantially free from carbon; to provide a process which permits the apparatus to be operated for an extended period without the

necessity of cleaning and in which that part of the system containing precipitated carbon is free from subjection to any excessive heat."

In his process Dubbs treats crude oil while in the Burton and Burton-Walker stills only gas oil (a lighter oil obtained from crude petroleum by distillation) could be used. The material to be treated is pumped into a nest of 4 inch tubes known as B tubes and during the time it is passing through said tubes they are subjected to sufficient heat to cause the desired amount of cracking. The oil is then passed into ten inch tubes designated as C tubes where vapor is liberated. This liberated vapor passes to an aerial condenser. The uncondensed vapor is passed on to other condensers. The vapor condensed in the aerial condenser is returned by gravity to the heating zone where, with the fresh feed, it is again subjected to cracking temperature. The residue in the C tubes is continually drawn off from these tubes. Pressure is maintained throughout the apparatus by means of a regulating valve. In the process a light fire may be maintained on the C tubes or they may be insulated to prevent loss of heat. In the illustrative run described in the patent Dubbs suggests subjecting the B tubes to a temperature of 750° F. to 860° F. and maintaining pressure on the oil of approximately 100
5728 pounds to the square inch "which is caused by the pressure of the generated vapors."

In the discussion of the issues presented in this case, it is agreed that claim 7 of the Dubbs patent may be taken as typical. That claim reads as follows:

> "7. A process of cracking oil consisting in continuously passing a stream of oil through a series of tubes seated in a cracking zone where the oil is heated to the cracking temperature but substantial vaporization prevented, and thence to an enlarged vapor chamber where vaporization takes place, removing the vapors from said chamber, subjecting them to an initial condenser where a portion of the vapors are condensed, subjecting the uncondensed portion of the vapors to a final condensation, returning the condensate from said initial condensation to the inlet side of the cracking tubes and continuously drawing off the residue from the vapor chamber and preventing it from returning to the cracking zone and maintaining a pressure on the oil during treatment."

Dubbs claimed many advantages over the processes then employed in the art. The cracking heat is applied to the B tubes only and as the cracking occurs principally in the C tubes there is no disposition of carbon, or cooking, in the B tubes and all danger from overheating of these tubes is eliminated. The reflux condensate is not returned to the shell or tubes containing the carbonaceous residue, but is returned to the tubes containing the fresh feed and passed directly to the heating zone. The carbonaceous residue from the cracking is withdrawn from the C tubes and as this is withdrawn fresh feed may be pumped into the B tubes enabling the operator to operate the apparatus for a long period of time. In a demonstration run at Independence, Kansas, the system remained on stream nine days and was shut down then because the oil men who had come to witness the demonstration said they were satisfied. The Dubbs process was recognized immediately by the larger oil companies as a great improvement in the art and the older processes of producing gasoline were practically abandoned.

Defendant contends, however, that there is nothing new in the Dubbs process except the "two-step" feature (heating the oil in one set of tubes and passing it into an-
5729 other where the cracking and deposit of carbon takes place) and in that Dubbs was anticipated by one Behimer; That all the other features of the Dubbs process, the return of the reflux directly to the heating coil instead of being returned to the chamber containing the carbonaceous residue and the constant withdrawal of the residue from the portion of the apparatus where the vapor separates from the heated oil, were old in the art and had been known for many years. On this phase of the case counsel for defendant cite British patent granted to Pielsticker No. 1308 of 1891, and United States Pielsticker patent No. 477,153, Hall patents No. 1,175,910 and 1,242,796, Ellis, No. 1,396,999, Alexander No. 1,407,619. Biddison and Boyd No. 1,345,740 and Greenstreet No. 1,740,691.

The Pielsticker patents were issued early in the 90's, the British patent in 1891 and the United States patent in 1892. By a rather strained construction counsel for defendant assert that they teach a withdrawal of residue and return of clear reflux to the heating tubes, but I do not find such teaching. The process as described by Pielsticker

appears to be nothing more than simple distillation. A dome appears to be located with the distillation chamber, but it is not a condensing chamber such as is used as a necessary feature of a cracking operation. It is intended apparently to catch the droplets of oil that may be carried with the vapors and prevent their being carried over into the chamber where the vapors are condensed.

The Hall patents describe a vapor phase process, a process negatived by Dubbs, they do not teach a cycling process and the process of these patents when tried out by the Texas Company proved inoperable. It is stated by counsel for defense that the Texas operation was not that of the Hall patents, but if it was not Hall was employed by the Texas Company to construct a plant, the company had knowledge of his patents and his process or processes were never used by the company.

5730 The Ellis patent, which shows a vapor phase process, does not teach a re-cycling process. The construction of the system as shown by his drawings is such as to prevent the return of reflux condensate to the heating tubes.

Alexander teaches eight different variations of cracking process, none of which had sufficient merit to induce an oil company to actually put them to use. The Gulf Oil Company did experiment with some one of the eight variations suggested by Alexander, though which one the testimony does not clearly show; but the experiment cost the company a million and a half dollars and was a failure. That was the end of the Alexander processes so far as practical use was concerned. The patent in its descriptions and claims is very confusing and I am unable to find that it teaches the Dubbs process.

Biddison and Boyd teach three systems, only one of which, it is claimed, anticipate Dubbs. The teachings of this patent are not clear but after careful study, it seems to me it teaches a vapor phase system and that it does not teach a circulatory system such as Dubbs with a clean reflux being returned to the cracking tubes.

As to Greenstreet, if I correctly understand the testimony of the experts of the respective parties, the reflux returned for reheating contains the carbonaceous residue and is not clean.

With great skill and ingenuity counsel for defendant

have argued that these patents clearly teach all that is contained in the Dubbs process. But the stubborn fact remains that the great oil companies with their staffs of highly trained technical experts never found it out. The Standard Oil Company of California maintained a research department in which some 200 technicians were employed at a cost of over a million dollars a year. Other great oil companies, such as Texas, Gulf and Shell undoubtedly maintained laboratories and technicians to work on the problems presented by the process of obtaining gasoline by cracking heavier petroleum oils. If the prior art 5731 taught clean circulation so clearly how did it happen that nothing better than the Burton and Burton-Clark systems was developed? It was not until Mr. Hanna, a representative of Standard Oil of California visited a plant of the Shell Company at Martinez that the company learned the advantage of clear circulation and he wrote to his company:

> "In studying over these reports, it would seem to me that we have picked up the following:
>
> "1st. Cleanliness is next to Godliness.
>
> "2nd. That the Dubbs people anticipate us in an appreciation of cleanliness.
>
> "3rd. That circulation can be obtained without the use of a pump.
>
> "4th. That higher pressures are very desirable.
>
> • • •
>
> "5th. That if the maximum degree of cleanliness is maintained, higher furnace efficiency can be attained."

Mr. Hanna testified further:

> "When we discovered the clean circulation, which we found out at the Martinez unit, *we threw our hands up in the air and gave a cheer, that we had found a solution to our problem*, and we immediately went to work to get out our plans and designs to convert the 15 and 20 units."

Prior to the investigation of the Dubbs process by Standard of California the Royal Dutch Shell group of companies had become interested and sent their Mr. Pyzel, a chemical engineer who supervised the construction of refineries and their operations in this country for Shell com-

panies, to investigate the Dubbs process and early in 1919 he observed the operation of the Dubbs experimental plant at Independence, Kansas. His company was owner of the Trumble patent. Concerning his observations he testified:

"My conclusion was that the Dubbs process as demonstrated to me in Independence, Kansas, showed one particular feature which made it far superior to the Trumble process which we were trying to develop ourselves, and that for that reason it would be to the interest of our company to come to some arrangement with the Universal Oil Products Company regarding their process."

. . . . . .

5732 "It was our conviction that * * * we should try to develop a process in which the heating of the oil to be cracked should take place in a tubular furnace through which the oil was flowing with sufficient velocity to prevent as much as possible the deposition of such material on the heating surface.

"Our work with apparatus built after the Trumble process mentioned before was going in this direction, but after witnessing the operation of the plant in Independence, I realized that we had made in this work a serious mistake, which was the returning of the heavier residual liquids from the evaporator to the cracking tubes.

. . . . . .

"At the Dubbs plant at Independence such heavy residual liquid was not returned to the tubes, and only the raw oil mixed with the condensed heavy distillate entered those tubes. The result was that in the Dubbs plant at Independence the difficulties with coke forming in the tubes were very largely eliminated, but this same difficulty was practically the failure of our own efforts with the Trumble process."

He further testified:

"And then when we saw this apparatus at Independence, Kansas, I said, '*My God, why didn't I think of that, to take that residuum out and have only clean reflux go back.*' And that is the reason that we wanted to make the agreement with Dubbs, and that is why I expressed in that other letter in which I said, 'Well, we ought to recognize that we have been beaten by Dubbs'."

Thereafter practically all of the great companies took out licenses under the Dubbs patents (the patents in suit and certain other patents) paying millions of dollars in royalties for the privilege.

This is more than mere commercial success. Here the recognized experts in the art saw the Dubbs process as new and revolutionary. And who was better qualified to judge? *Webster Loom Co.* v. *Higgins*, 105 U. S. 580, *The Gray Processes Corporation* v. *Danciger Oil & Refineries Inc.*, 42 U. S. P. Q. 317.

Perhaps more serious is the contention of defendant that Dubbs was anticipated by the work done by one Otto Behimer who filed an application for a patent on a cracking process November 21, 1918, almost four months earlier than Dubbs who filed his on March 19, 1919.

Behimer conceived the idea of clean circulation and
5733 the advantage which would result therefrom earlier than did Dubbs. He conceived some of the steps necessary to produce the desired result. He had worked out a method of heating the oil to a cracking temperature in one set of tubes, transferring this heated oil to a separate chamber where cracking should take place without the application of additional heat and carrying the vapors to a condensing chamber. But here he was balked. It was necessary to the operation of his system as he conceived it (and as Dubbs worked it out) to return the reflux to the heating coil and this he did not know how to do. It did not occur to him, as it did to Dubbs, to return the reflux by force of gravity. He thought of only one way, the use of a pump, but so far as the evidence shows there was no pump on the market, and Behimer knew of none, capable of handling this hot oil. He experimented with a jet pump but it did not work satisfactorily.

Behimer at this time was in the employ of the Texas Company and had the use of all the facilities of that great corporation. He consulted with Holmes, president of the company and one of the outstanding engineers in the oil industry. Experimental plants were erected by the Texas Company, but abandoned. As Behimer testified there was a "joker" in his conception of the process, he did not know of any means of returning the reflux to the heating coils.

The Texas Company caused the application for a patent, to be filed while experiments were being carried on, though it knew Behimer had not then conceived a workable process.

This application was filed prior to the filing of Dubbs application. This filing, defendant contends, constituted a reduction to practice. But such is not the law. If the application for the patent is to constitute reduction to practice the specification must be such as to enable one skilled in the art to construct a workable apparatus. *Curtis Aeroplane & Motor Corporation* v. *Janin*, 278 Fed. 454, 457.

5734 One is not the discoverer of a new process until he has worked out all the steps necessary to produce the result he desires. To hold otherwise would be absurd. Behimer in his application stated that the reflux should be returned to the heating zone, but he did not state how that could be accomplished and he did not then know.

His application and his drawing accompanying it shows a jet pump whose function is to return the reflux to the heating coil, but in his testimony admits that the jet pump did not work. We have here a situation where an application for a patent is filed when it is known that the method described was unworkable.

It was not until 1923, when the Texas Company received a circular advertising a pump devised by one Thompson that it again began to experiment with Behimer's conception. It did not use the Thompson pump but worked out a pump of its own device and this pump worked satisfactorily. Then, for the first time, in my opinion, was the Behimer conception reduced to practice.

The situation here is not the same as in the *Telephone cases*, 126 U. S. 1, cited by defendant to sustain its position that Behimer anticipated Dubbs. In that case it appeared that when Bell applied for his patent he had never actually transmitted telegraphically spoken words so that they could be distinctly heard. But he did actually describe a workable process. The only reason it had not worked was that it had not been carefully constructed, but as the court said (pp. 535, 536) "other instruments carefully constructed and *made exactly in accordance with the specification*, without any addition whatever, have operated and will operate successfully." (Emphasis mine.)

The failure of the Behimer system to operate was not the result of carelessness in construction, but was due to a fundamental defect, a lack of any means, conceived
5735 by Behimer, of successfully returning the reflux to the heating coil.

It has been suggested that even if the jet pump was not

successful still nothing more than ordinary mechanical skill was necessary to find a method of returning the reflux. But the fact remains that neither the Texas Company headed by an outstanding oil engineer and with a great staff of experts, nor Behimer, a man of great ability, could or did think of a way. The method of returning the reflux by hydrostatic pressure seems simple now. It might seem to a court that ordinary mechanical skill would suggest that method but it is for the court now to say, in the face of the fact that the method did not occur to men of great skill who were earnestly working on the problem, that just ordinary mechanical skill was all that was necessary. *Barbed Wire Cases*, 143 U. S. 275, 283.

It is further suggested by defendant that Behimer's success with small laboratory equipment constituted a sufficient reduction to practice. It is true that it is not necessary always, to show an operation of a successful commercial plant. *Howard* v. *Humphries* (C. C. P. S.) 97 F. (2d) 616. But it appears from the report of that case that while the operation was carried on in a small still the inventor immediately had larger stills fabricated in which the operation was successfully carried on a commercial scale and the experts testified, apparently without contradiction, that the results obtained in the large stills would be very close to the results obtained in the small stills, that there would be some but not a significant difference, and that the "light obtained" as the result of such a small experimental operation would hold true when that operation was magnified into a large and useful shell still cracking operation.

The inventor in this case had succeeded. Behimer had failed. That he had failed was conclusively evidenced by the fact that he abandoned all experiments on his 5736 process for several years. The only purpose in filing the application for the patent, as it appears to me, was to have it on record as an anticipation to be used against some one who might design a workable process.

It is true that commercial production is not necessary to constitute reduction to practice but it is also true that a process which cannot be successfully operated commercially does not satisfy the requirement that only *useful* processes may be patented. *Besser* v. *Meritat Culvert Co.*, 243 Fed. 611, *Houston* v. *Brown Co.*, 270 Fed. 445, 448.

Behimer in his testimony stated that he had the idea of returning the reflux by hydrostatic pressure, but in this he stands uncorroborated, and the elevation of the reflux con-

denser on one of the drawings of a draftsman of the Texas Company was considered by Behimer to be too great and he directed that it be lowered, noting on the drawing that the elevation should be "10 feet maximum".

We come now to a more serious problem. Does defendant's process infringe the Dubbs patent?

Defendant's process is essentially as follows: A fairly clean distillate is fed in a stream to cracking coils and subjected to temperatures up to 940° F. and pressures of 500 pounds. As this stream leaves the cracking coils, the stream is passed through a valve by which the pressure is reduced to 26 pounds. Then a second stream is conducted into the first, this second stream consisting of topped crude oil from a low pressure furnace. The merged stream is conducted into a "vaporizing chamber" (as plaintiff calls it) or "vapor separator" (as defendant calls it) where the vapors from the cracked stream pass out through the top into a bubble tower where partial condensation takes place, and from the top of which the vapors pass to a final condenser. The liquid residue which collects in the bottom of the vaporizing chamber, to use plaintiff's terminology, is drawn off and run to storage facilities. This residue is never re-cycled through the cracking tubes. The re-
5737 flux liquefied in the bubble tower is recycled through the cracking tubes.

Plaintiff concedes that the oil, when it reaches the temperature of 940° F. and runs from the cracking coils to the vaporizing chamber, is by weight 85 per cent vapor, and passes through the transfer line as foam.

Defendant contends that this process does not infringe plaintiff's patent. Whether there is infringement depends upon the meaning given to the word vaporization as used by plaintiff. In each of the claims of plaintiff's patent it is provided that in the passage of the oil through the initial tube substantial vaporization shall be prevented. Defendant says that the word vaporization means generation of vapor and that plaintiff's patent limits his process to one in which no vapor is generated in the initial tube or chamber where the heat is applied. Plaintiff says vaporization means liberation of vapors and that his patent provides for generation of vapor in the heating chamber and liberation in the second chamber. If plaintiff's interpretation is correct, defendant infringes. If, on the other hand, the term is to be given the meaning for which defendant contends, defendant does not infringe.

The generally accepted meaning of the word among scientists and the laity as well seems to be generation of vapor.[1]

It is true that a patentee in describing his invention and framing his claims is not bound by definitions given in dictionaries or scientific books. He may be his own lexicographer. *Northwest Engineering Corp.* v. *Keystone Driller Co.*, 70 F. (2d) 13. *He is "at liberty to supply* 5738 his own dictionary."[2] But if he uses a word in a sense other than that in which it is ordinarily used or is defined in dictionaries or scientific works, he must make clear the meaning he gives to the word. And if a word, as commonly accepted, has two or more meanings, the meaning he gives it must appear from the patent itself. *Dennis, et al.* v. *Pittner, et al.*, 106 F. (2d) 142, 148. The requirement of the statute (R. S. 4888, Title 35 U. S. C. Sec. 33) that the inventor shall describe his invention in full, clear and exact terms is not met by terms capable of different constructions. *In re Crowell*, 84 F. (2d) 206, 209. In determining the meaning one may search the whole patent, for, while the claims may not be broadened by the specifications, *Libbey Glass Mfg. Co.* v. *Albert Pick Co., Inc.*, 63 F. (2d) 269, *Minerals Separation Limited* v. *Butte & Superior Mining Co.*, 250 U. S. 336, 347, the specifications may be examined to determine what the inventor meant by the expressions used in his claims. *Horton Mfg. Co.* v. *White Lily Mfg. Co.*, 213 Fed. 471, 473. If upon examination of the whole patent it clearly appears that Dubbs used the term to mean liberation of vapor the court must give it that meaning. Otherwise it must be given the usual and dictionary meaning.

On page 1 line 15 he says, "among the salient objects of the invention are to provide a process in which the oil is continuously fed through the *cracking zone* and thence through the *vapor zone* and a portion of the generated vapors condensed and returned to the inlet side of the cracking zone for further treatment." (Emphasis mine.)

Here there is nothing to indicate clearly whether he uses

(1) See Carhart, Physics for College Students (1910), p. 375 Spinney, A Text Book of Physics (1925) p. 196, Barker, Physics Advanced Course (1892) p. 309, Herring, Essentials of Physics for College Students (1912) p. 115, Shrader, Physics for Students of Applied Science (1937) pp. 198, 202, Norris, A Text Book of Inorganic Chemistry, (1921) p. 163, Ferry, General Physics and its Application to Industry (1921) p. 268, Encyclopedia Brittanica, 14th ed. Vol. 22, p. 979, and Webster, Funk & Wagnall's Standard and Oxford Dictionaries.

(2) *Jones* v. *Sykes Metal Lath & Roofing Co.* 254 Fed. 91.

the term vapor zone to indicate generation or liberation of vapor, though possibly the reference to feeding the oil "through the vapor zone and a portion of the generated vapors condensed and returned to the inlet side of
5739 the cracking zone" might indicate that he meant by "vapor zone" a place where vapor is generated.[3] Later describing the apparatus, page 1, line 52, he says, "B are the cracking tubes, C are the vaporizing tubes." Next, he gives a description of the process and states, page 1, line 75, that the charging stock is passed "through tubes B and during the time they (sic) are passing through said tubes, they are subject to sufficient heat to cause the desired amount of cracking." It will be noted that he does not say the desired amount of cracking occurs in the B tubes and from the whole patent it is clear that what he is attempting is to impart to the oil in the B tubes the heat that will cause it to crack in the C tubes.[4] "Said oil is then passed into the tubes C which are only partially filled with the oil and as the oil passes through these tubes there is a liberation of vapors from the same" (lines 79-83) and the vapors then pass up to the initial condenser. That Dubbs thought vapor was generated in the C tubes is indicated by his further statement, page 1, line 108, that the per cent of vapors *generated* from the oil as it *passes through the C tubes* will depend on the amount of heat acquired by said oil while passing through the B tubes. In one other passage of the patent, lines 28 to 32, page 2, he says, "It will be noted that the reflux condensate is in all cases trapped off from the vapor lines in such manner as to prevent their (sic) returning direct to the vaporizing tubes C" but nothing in the paragraph indicates whether he uses the word "vaporizing" to mean vapor generation or vapor liberation.

5740 These are all the references to vaporization in the description of the invention as originally filed. In the claims in the original application no reference was made of prevention of vaporization in the B tubes and I am of the opinion that Dubbs had no clear idea of what happened in the B tubes and that he did not consider it important.

(3) There is confusion, too, in the use of the term "cracking zone". Here he is evidently referring to the B tubes, but he states that the carbon containing residue is continuously removed from the cracking zone, by which, of course, he means the C tubes. (Page 1, line 22).

(4) Temperature and time are the essentials for "deep cracking", that is a cracking that will produce gasoline. The oil must be brought to the required temperature and kept at that temperature for a sufficient time."

Plaintiff relies heavily on a description of an illustrative run in the application to sustain its theory that the term vaporization should be construed to mean liberation rather than generation of vapor. In this illustrative run Dubbs used crude oil of 32 to 36 Baume gravity and the 4 inch B coils are subjected to a temperature of 750° to 860° F. The heated oil then passes to the 10 inch C coils which are maintained about half full of oil "wherein vaporization takes place." A pressure of approximately 100 pounds to the square inch is maintained on the oil during treatment "which is caused by the generated vapors." It must be noted, however, that this description of the illustrative run was not in the original application but was inserted in the first amendment to the original application. The limitation of the process in the claims to one in which substantial vaporization is prevented in the B tubes was added in the third amendment filed more than two years later.

Dr. Brown, the expert called by plaintiff, testified at great length as to his understanding of the Dubbs specification and the performance of the process thereunder. He said:

> "There is no separation of the liquid from the vapor or the vapors from the liquid in these tubes B.
>
> * * * * * *
>
> "I believe it is impossible to operate according to the principles set forth in the Dubbs patent and not obtain vapor generation in the B tubes."

5741 Brown further testified that the illustrative run described in the Dubbs specification prescribed conditions under which the oil leaving the cracking tubes B would contain upwards of ninety per cent by weight of vapors generated within the oil. Separation of the generated vapors was prevented by the velocity of the passage of the oil through the B tubes, and Dr. Brown testified and plaintiff urges that the teaching of the patent with respect to this velocity was found in the showings of the hydrostatic head in the drainage system due to the elevation of the partial condenser, and the showing of the small number and the short length of the B tubes, which for efficient heating of the oil, required that the oil should move through these small tubes with as much velocity as possible.

If, as seems implicit in this argument, the number and length of the B tubes was such as to require forcing the oil there through at high velocity, and this velocity was necessary to prevent "substantial vaporization" therein, the patent is wholly silent upon these critical factors of the invention.

Dr. Brown also relied upon a comparison of the claims originally presented in the Dubbs application with those finally allowed as indicating a recognition by Dubbs of generation of vapors (without liberation thereof) in the B tubes. Thus, claims 1 and 2 originally presented opened with these respective passages:

> Claim 1. *A* process of converting heavy into lighter hydrocarbons, consisting in passing the oil through a heating coil in a cracking zone, passing the oil and *generated vapors* into a vapor chamber, taking off the vapors from said vapor chamber, * * *
>
> Claim 2. A process of converting heavy into lighter hydrocarbons, consisting in passing the oil through a heating coil in a cracking zone, passing the oil and *generated vapors* into a vapor chamber, taking off the vapors from said vapor chamber, * * *

5742 But it should be noted that while in these two claims in the original application Dubbs spoke of passing the "oil and generated vapors" from the B to the C tubes, in the first amendment no mention was made in any claim of generation of vapors in the heating zone, but in each he referred simply to passing the oil through a zone of reaction, or a cracking zone or heating zone. In the second amendment ten of the claims provided for the passage of oil through a heated zone of reaction and thence to an enlarged chamber where vaporization takes place, the 11th provided for passing a stream of oil through a series of tubes seated in a cracking zone and the 12th for progressively passing the oil through a heated zone of reaction and then passing the *heated* oil through a vaporizing zone. Finally in the third amendment the claims were worded as they now stand each claim containing a clause prohibiting substantial vaporization in the B tubes. Never after the cancellation of the claims first filed was there any mention of vapor being generated in the B tubes.

Though we do not place our decision on the narrow ground that Dubbs barred himself (and plaintiff) by estoppel from now contending that his patent permits generation of vapors in the B tubes it does appear from the holding of the Supreme Court in *Schriber-Schroth* v. *Cleveland Trust Co.*, 311 U. S. 211, that because of Dubbs cancellation of the first two claims of his original application plaintiff is in no position now to assert for the present claims the same scope as those of the claims cancelled.

I am forced to the conclusion that the patent does not

show that Dubbs used the term vaporization in any other than the commonly accepted meaning of generation of vapor. As Judge Evans said in *Colgate Palm Olive Peet Co. et al.* v. *Lever Bros. Co.*, 90 F. (2d) 178, "Restric-
5743 tive words in a patent must be given their true meaning even though a worthy invention be rendered valueless thereby". And the true meaning of the word "vaporization" as used in this patent, it seems to me, is generation of vapors. Given this construction defendant's process does not infringe.

It still remains to consider the Egloff patent. In this process fuel oil may be heated to a temperature of 700° F. and subjected to a pressure of 135 pounds in a heating coil and delivered through an insulated transfer line to a large, cylindrical expansion chamber, the contents of which are subjected to the same pressure. There is a vapor outlet pipe through which the vapor passes to a condenser and the condensate is pumped back to a second heating coil where it is subjected to a pressure of 175 pounds and a temperature of 770° F. and from there it passes to the transfer line above mentioned through which the charging stock is passing from the coil in which it has been heated to the expansion chamber. While "on stream" therefore there is continually passing into the expansion chamber a stream composed of the fresh feed which has been subjected to a temperature of 700° F. and pressure of 135 pounds and the reflux condensate which has been reheated to a temperature of 770° F. and subjected to pressure of 175 pounds. But what benefit comes from this reheating of the reflux condensate and subjecting it to the pressure mentioned I cannot determine from the evidence. And it does not appear to have been ever used, commercially. Nor do I find anything involving invention. In my opinion this patent is invalid.

These same two patents were involved in a case in the District Court for the District of Delaware, *Universal Oil Products Co.* v. *Winkler-Koch Engineering Co., et al.*, 6 Fed. Supp. That court held the patents valid and in-
5744 fringed, and the judgment was affirmed by the Circuit Court of Appeals. *Root Refining Co.* v. *Universal Oil Products Co.*, 93 F. (2d) 186. It is with reluctance that I feel compelled to disagree, in part, with those courts.

The defendant is entitled to a decree dismissing plaintiff's bill of complaint.

William H. Holly,
Judge.

Filed Oct. 14, 1941. 5745 FINDINGS OF FACT AND CONCLUSIONS OF LAW, filed Oct. 14, 1941:

5746 Findings of Fact.

1. Plaintiff is a corporation of the State of Delaware. Defendant is a corporation of the State of Illinois, doing business at Lemont, Cook County, Illinois, and elsewhere.

2. Plaintiff is the owner of patent No. 1,392,629, issued to Carbon P. Dubbs on October 14, 1921, and assigned to plaintiff, and patent No. 1,637,593, granted to plaintiff on May 12, 1925, on the application of Gustav Egloff. Both patents relate to a process of producing from heavier petroleum products a lighter oil capable of being used in internal combustion engines. The claims in suit are all the claims, save claim 6, of the Dubbs patent and all the claims of the Egloff patent. Plaintiff relies on claim 7 of Dubbs as a typical claim.

3. Petroleum as it comes from the ground contains a variety of compounds composed of hydrocarbon molecules,
5747 the various molecules being composed of atoms of hydrogen and carbon differently arranged and with differing numbers of hydrogen and carbon atoms.

4. The process known in the oil refining art as "cracking" is the subjection of hydrocarbon oil to a sufficient heat for a sufficient period of time to cause a molecular change or rearrangement resulting in the formation of new substances, some lighter and some heavier than those originally present in the oil.

5. It was known that gasoline could be produced from the heavier oils by cracking, and various inventors had been exploring the possibilities of so producing gasoline in commercial quantities. The Burton process put into operation by the Standard Oil Company of Indiana during the year 1912 was the first practical oil cracking process to make gasoline that met with commercial success. In this process a clean gas oil stock which had theretofore been obtained from crude petroleum by distillation was charged into a shell still set over a furnace. The charge was heated to a temperature of from 700° F. to 750° F. for a sufficient period of time to cause cracking. The operation was conducted under an autogenous pressure of about 75 pounds resulting from the vapors and non-condensible gases produced by the heating and cracking operation, and the vapors generated thereby passed up

through vapor tubes where they were subjected to partial condensation and the heavier portion, termed "reflux condensate", was returned through the long vapor line to the shell where it was subjected to further treatment. The uncondensed vapor was passed on for final condensation and further processing. About 12 hours were re-
3748 quired to bring the oil to the proper temperature and pressure, and the still remained "on stream" for about 24 hours, when it became necessary to draw the fires, withdraw the oil remaining in the still, and remove the carbonaceous material which had been formed during the operation and which adhered to the inner wall of the shell. This shutdown and cleaning operation required about 12 hours.

6. The Burton process had several disadvantages. The "on stream" period was limited to about 24 hours out of every 48 hours because experience had shown that the carbonaceous material accumulating on the bottom of the shell acted as an insulator and caused "hot spots" to appear on the directly fired shell. If the "on stream" period was unduly extended, the shell bottom would give way at the "hot spots" with resulting explosions, causing loss of life and property damage. Only about 28% of the total charge in the Burton process was recoverable as gasoline.

7. The Burton-Clark process was an improvement over the Burton process and was devised to overcome the danger of overheating experienced in the Burton process. The Burton-Clark process was put into operation in about 1915. In this process the oil was heated by passing it through a nest of 4-inch convection tubes placed within the furnace, the tubes being connected with the shell and the oil passing thermocychically through the shell and tubes. Cracking temperatures used in the Burton-Clark process were from 720° F. to 725° F., and the pressure was approximately 95 pounds maintained on the
3749 entire system. Refluxing and condensation of the distillate was substantially the same as in the Burton process.

8. The cycle of operation in the Burton-Clark still was 72 hours, which included 15 hours necessary to bring the still up to pressure, 36 hours "on stream," and the remainder of the time for shutting down, cleaning, and again getting the still ready for operation. The "on stream" period was limited to 36 hours for the same reason that the

period was limited to 24 hours in the Burton process, namely, that coke accumulated where the heat was directly applied, resulting in "hot spots" which caused frequent rupture and buckling of the tubes.

9. The Burton and Burton-Clark processes constituted the state of the art as practiced commercially when Dubbs appeared on the scene. The problem to be solved was to crack the heavier hydrocarbons to produce gasoline without coking up the vessel in which the cracking occurred. Dubbs solved the problem.

10. In the process of the Dubbs patent the material to be treated, which may be crude oil and is not limited to the gas oil charge of the Burton and Burton-Clark stills, is pumped into a nest of 4 inch tubes called B tubes in the patent, and during the time the oil is passing through said tubes they are subjected to "sufficient heat to cause the desired amount of cracking." This does not mean that the desired amount of cracking occurs in the B tubes. The oil must be brought to the required temperature and kept at that temperature for a sufficient time to affect deep cracking, that is, a cracking that will produce gasoline. In the patented process, Dubbs imparts to the oil in the B tubes the cracking heat that will cause it to crack in the 10 inch C tubes into which the oil is passed from the B tubes. The C tubes are lightly fired or insulated and the cracking principally occurs therein. In the C tubes vapors are generated as the result of cracking, and these vapors are also liberated from the liquid and are passed to an aerial condenser in which the heavier portions are condensed and returned by gravity to the heating zone or B tubes where, with the fresh feed, they are again subjected to cracking temperatures. The uncondensed vapor passes from the aerial condenser to a final condenser. The carbonaceous residue in the C tubes is continuously drawn off and not returned to the system. Pressure is maintained throughout the apparatus by means of a regulating valve on the outlet of the final condenser. In the illustrative run described in the patent Dubbs suggests subjecting the B tubes to a temperature of 750° F. to 660° F. and maintaining pressure on the oil of approximately 100 pounds to the square inch "which is caused by the pressure of the generated vapors."

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11. The process of the Dubbs patent has many advantages over the processes then employed in the art. The cracking heat is applied to the B tubes only, and as the

cracking occurs principally in the unheated or lightly fired C tubes, the deposition of carbon and carbonaceous material resulting from the cracking operation occurs in a safe place, and danger from overheating the B tubes where the cracking heat is imparted is eliminated. The carbonaceous residue is withdrawn from the C tubes and the reflux condensate is not returned to the shell or C tubes containing the carbonaceous residue, but is returned
5751 to the entrance and of the B tubes with the fresh feed. The Dubbs process enabled the operator to operate the apparatus for a long period of time. In a demonstration run at Independence, Kansas, the system remained "on stream" nine days and was shut down then because the oil men who came to witness the demonstration said they were satisfied.

12. The Dubbs process was recognized immediately by the larger oil companies as a great improvement in the art, and the older processes of producing gasoline were practically abandoned.

13. The principle of clean circulation taught in the Dubbs patent is not found in the prior art patents relied upon by the defendant which are British Pielsticker patent No. 1308 of 1891, and United States Pielsticker patent No. 477,153, Hall patents Nos. 1,175,940 and 1,242,796, Ellis patent No. 1,398,999, Alexander patent No. 1,407,619, Biddison and Boyd patent No. 1,345,740, and Greenstreet patent No. 1,740,691. These patents do not teach the Dubbs process to those skilled in the art.

14. The Pielsticker patents do not disclose a teaching of return of clean reflux, unmixed with residue, to the heating tubes, and the process described by Pielsticker appears to be nothing more than simple distillation. Pielsticker's dome is not a condensing chamber such as is used as a necessary feature of a cracking operation but is intended apparently as an entrainment knockout to
5752 catch the droplets of oil that may be carried with the vapors and to prevent their being carried over into the chamber where the vapors are condensed.

15. The Hall patents describe a vapor phase process, a process negatived by Dubbs. They do not teach a cycling process, and the process of these patents, when tried out by the Texas Company, proved inoperable.

16. The Ellis patent discloses a vapor phase process and does not teach recycling of the reflux. The construction of the system as shown by the patent drawings is such

as to prevent the return of reflux condensate to the heating tubes.

17. The Alexander patent teaches eight different variations of a cracking process, none of which had sufficient merit to induce any oil company to actually put them to use. The Gulf Oil Company experimented with some one of the eight variations suggested by Alexander, though which one the testimony does not clearly show, but the experiment cost the company a million and a half dollars and was a failure, this being the end of the Alexander processes so far as practical use was concerned. The Alexander patent in its discription and claims is very confusing and does not teach the Dubbs process.

18. The Biddison and Boyd patent teaches three systems only one of which is asserted to anticipate Dubbs. The teachings of this patent are not clear, but it is a vapor phase system, and it does not teach a circula-
5753 tory system such as Dubbs with a clean reflux being returned to the cracking tubes.

19. The Greenstreet patent, according to the testimony of the experts for both plaintiff and defendant, does not disclose the return of a clean reflux, for the reflux returned for reheating contains the carbonaceous residue and is not clean.

20. That the prior art did not teach clean circulation is shown by the fact that the great oil companies such as Texas, Gulf, Shell, and the Standard Oil Company of California, with their staffs of highly trained technical experts, never discovered this principle in the prior art.

21. The Standard Oil Company of California maintained a research department in which some two hundred technicians were employed at a cost of over a million dollars a year, and it was not until Mr. Hanna, a representative of the Standard Oil of California, visited a Dubbs plant of the Shell Company at Martinez which embodied the principle of clean circulation that Standard learned the advantages thereof.

22. Prior to the investigation of the Dubbs process by Standard of California, the Royal Dutch Shell group of companies had become interested and sent their representative, Daniel Pyzel, a chemical engineer, who supervised the construction of Shell refineries and their operation in this country, to investigate the Dubbs process,
5754 and early in 1919 he observed the operation of the Dubbs experimental plant at Independence, Kansas,

and reported to his company that the Dubbs process eliminated the difficulties which Shell had formerly experienced in its efforts with the Trumble process.

23. Subsequently practically all the large refining companies took out licenses under the Dubbs patents comprising the patents in suit and certain other patents and paid millions of dollars in royalties for the privilege. This is more than commercial success. Here the recognized experts in the art saw the Dubbs process as new and revolutionary, and no one was better qualified to judge.

24. Prior to Dubbs' invention, one Otto Behimer, then an employee of The Texas Company, conceived the idea of clean circulation and some of the steps necessary to produce the desired result and the advantage which would result therefrom. Behimer had worked out a method of heating the oil to a cracking temperature in one set of tubes, transferring this heated oil to a separate chamber where cracking would take place without the application of additional heat, and taking off the vapors to a condensing chamber from which, as he conceived his system, the reflux was to be returned to the heating coil while the residue was continuously withdrawn. However, Behimer did not know how to return the reflux to the heating coil. He did not think of returning it as did Dubbs by force of gravity. Behimer thought of only one way to return the reflux, and this was by the use of a pump, but there was no pump on the market, and Behimer knew of none, that was capable of handling the hot oil. He experimented with a jet pump but it did not work satisfactorily. Behimer at this time was in the employ of The Texas Company and had the use of all of the facilities of that great corporation. He consulted with Holmes, president of the Company and one of the outstanding engineers in the oil industry. Experimental plants were erected by The Texas Company, but abandoned. As Behimer testified, there was a "joker" in his conception of the process. He did not know of any means of returning the reflux to the heating coils.

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25. Behimer's testimony that he had the idea of returning reflux by hydrostatic pressure is uncorroborated and is negatived by the fact that on one of The Texas Company drawings, he decreased the elevation of the dephlegmator.

26. While Behimer was conducting experiments, The Texas Company, although it then knew that Behimer had

not conceived a workable process, caused an application to be filed on November 21, 1918, almost four months earlier than Dubbs, who filed his application on March 19, 1919. At the time of filing his application, Behimer had not worked out the steps necessary to produce the result he desired because he did not have a pump and did not know of any pump which would return the reflux to the heating coils. It was not until 1921 when The Texas Company received a circular advertising a pump devised by one
5756 Thompson that it again began to experiment with Behimer's conception. It did not use the Thompson pump, but worked out a pump of its own device, and this pump worked satisfactorily.

27. The method of returning reflux by hydrostatic pressure did not involve mere mechanical skill. The inventor in this case had succeeded. Behimer had failed. The failure of the Behimer system to operate was not the result of carelessness in construction, but was due to a fundamental defect,—a lack of any means, conceived by Behimer, of successfully returning the reflux to the heating coil.

28. All the claims of the Dubbs process are limited by the requirement that in the passage of the oil through the initial tubes or B tubes substantial vaporization shall be prevented.

29. In the defendant's process the oil in the cracking coils reaches a temperature of 940° F. and is vaporized therein to the extent of 85% by weight. It passes through the transfer line to the vapor separator as foam. Other features of the defendant's process are as follows: A fairly clean distillate is fed in a stream to cracking coils and subjected to temperatures up to 940° F. and pressures of 500 pounds. Approximately 94% of all the cracking to
make gasoline occurs in defendant's cracking coil, and
5757 6% in its vapor separator. As this stream leaves the cracking coils, the stream is passed through a valve by which the pressure is reduced to 26 pounds. Then a second stream is conducted into the first, this second stream consisting of topped crude oil from a low pressure furnace. The merged stream is conducted into a "vaporizing chamber" (as plaintiff calls it) or "vapor separator" (as defendant calls it) where the vapors from the cracked stream pass out through the top into a bubble tower where partial condensation takes place, and from the top of which the vapors pass to a final condenser.

The liquid residue which collects in the bottom of the vaporizing chamber, to use plaintiff's terminology, is drawn off and run to storage facilities. This residue is never recycled through the cracking tubes. The reflux liquified in the bubble tower is recycled through the cracking tubes.

30. The generally accepted meaning of the word "vaporization" among scientists and the laity is the generation of vapor.

31. An examination of the whole Dubbs patent does not show that the patentee used the word "vaporization" in any other than its commonly accepted meaning of formation or generation of vapors. The true meaning of the word "vaporization" as used in the patent is generation of vapors.

32. In the original claims submitted in the application for the Dubbs patent there was no reference to preventing vaporization in the B tubes, and Dubbs then had no clear idea of what happened in the B tubes and 5758 did not consider it important. The limitation of the process in the claims to one in which substantial vaporization is prevented in the B tubes was added in the third amendment more than two years after the application was filed.

33. Plaintiff's contention that the word "vaporization" in the Dubbs patent means the separation of vapors from liquid, or the generation and separation, finds no support in the Dubbs patent.

34. If "without substantial vaporization" means maintaining the oil in the B tubes in the form of a foamy mass caused by passing it there through at high velocity, there is no teaching to this effect in the patent, which is wholly silent upon this critical feature of the invention.

35. In the prosecution of the claims in the application for the Dubbs patent only claims 1 and 2 first submitted spoke of passing "oil and generated vapors" from the B to the C tubes. These claims were canceled and in the claims thereafter submitted there was never any mention of generated vapors in the B tubes. In the final amendment the claims were worded as in the issued patent wherein each claim contains a clause prohibiting substantial vaporization in the B tubes.

36. In the Egloff patent fuel oil is heated to a temperature of 700° F. and subjected to a pressure of 135

pounds in a heating coil and delivered through an
5759 insulated transfer line to a large cylindrical expansion chamber, the contents of which are subjected to the same pressure. Vapors pass through a vapor outlet to a condenser, and condensate is pumped back to a second heating coil where it is subjected to a pressure of 175 pounds and a temperature of 770° F. The condensate then passes through the transfer line where it mingles with charging stock, and the mixed stream is delivered to the expansion chamber. While "on stream" there is continually passing into the expansion chamber a stream composed of fresh feed, which has been subjected to a temperature of 709° F. and a pressure of 135 pounds, and the reflux condensate which has been reheated to a temperature of 770° F. and subjected to a pressure of 175 pounds.

37. The evidence does not disclose any benefit resulting from the separate treatment of the reflux in the Egloff patent.

38. The Egloff patent was never used commercially.

5760 Conclusions of Law.

1. The Court has jurisdiction of the parties and of the cause of action.

2. The Dubbs patent is valid but not infringed.

3. A patentee, in describing his invention and framing his claims, may be his own lexicographer and is not bound by definitions given in dictionaries or scientific works, but if he uses a word in a sense other than that in which it is ordinarily used or is defined in dictionaries or scientific works he must make clear the meaning he gives to the word, and if a word as commonly accepted has two or more meanings, the meaning he gives it must appear from the patent itself.

4. Restrictive words in a patent must be given their true meaning even though a worthy invention be rendered valueless thereby.

5. The requirement of the statute (R. S. 4888, Title 35, U. S. C., § 33) that the inventor shall describe his invention in full, clear, and exact terms is not met by the use of terms capable of different constructions.

6. In determining the meaning of a word used in a patent one may search the whole patent, for while the

claims may not be broadened by the specification, the
5761 specification may be examined to determine what the inventor meant by the expressions used in his claims.

7. Allowed claims can never be given the same scope as prior broader claims which were rejected and canceled.

8. One is not the discoverer of a new process until he has worked out all the steps necessary to practice the process.

9. Behimer's work done prior to Dubbs' invention is not prior invention of the subject matter of the Dubbs patent because Behimer did not know of, or have, any means for returning the reflux to the inlet of the heating tubes.

10. Behimer's application for patent filed on November 21, 1918, did not constitute a reduction to practice of the invention of the Dubbs patent, because the Behimer application did not disclose any operable means of returning the reflux to the coil inlet, nor was any such means known to the art when Behimer's application was filed. Behimer's conception was not reduced to practice until a satisfactory reflux pump was devised by The Texas Company in 1921.

11. The method of returning reflux by hydrostatic head was not the exercise of mere mechanical skill but constituted patentable novelty.

5762 12. The Egloff patent is invalid for lack of invention and for lack of utility.

Enter:

(Sgd) William H. Holly,
United States District Judge.

October 14, 1941.

Approved as to Form:

(Sgd.) Alexander F. Reichmann,
Counsel for Plaintiff.

(Sgd.) J. Bernhard Thiess,
Counsel for Defendant.

October 14, 1941.

5763 JUDGMENT, entered October 14, 1941:

Entered Oct. 14, 1941.

5764 This cause coming on to be heard upon the pleadings filed herein and the testimony adduced by both parties, and having been briefed and argued by counsel for said parties, thereupon, upon consideration thereof,

It Is Hereby Ordered, Adjudged and Decreed as follows:

1. That plaintiff's Bill of Complaint be, and the same hereby is, dismissed, and

2. That defendant recover its taxable costs and disbursements from the plaintiff.

(Sgd.) William H. Holly,
United States District Judge.

October 14, 1941.

Filed Nov. 7, 1941. 5765 NOTICE OF APPEAL, filed Nov. 7, 1941:

IN THE UNITED STATES DISTRICT COURT,

For the Northern District of Illinois,

Eastern Division.

Universal Oil Products Company, *Plaintiff.*
vs.
Globe Oil & Refining Company, *Defendant.*
} In Equity No. 10,744.

NOTICE OF APPEAL.

Notice is hereby given that the plaintiff herein, Universal Oil Products Company, hereby appeals to the United States Circuit Court of Appeals for the Seventh Circuit from the Judgment entered in this suit on October 14, 1941 and from each and every part of said Judgment.

(Sgd.) A. F. Reichmann,
Attorney for Plaintiff.
231 South La Salle Street,
Chicago.

Filed 11-7-41.

5766 PLAINTIFF-APPELLANT'S STATEMENT OF POINTS UNDER RULE 9.

The plaintiff-appellant, in accordance with Rule 9 of this Court, hereby specifies the following points of alleged errors asserted and intended to be urged on this appeal.

1. The District Court erred in holding that defendant's accused process did not infringe Dubbs patent 1,392,629 in suit.

2. The District Court erred in holding that the word

"Vaporization" as used in the claims of said Dubbs patent means "generation of vapors", and in holding that it does not mean "liberation of vapors".

3. The District Court erred in failing to give proper consideration to the illustrative run described in the specification of said Dubbs patent in determining the meaning of the word "vaporization" as used in said patent.

5767 4. The District Court erred in failing to give proper consideration to claims originally presented with the application eventuating in said Dubbs patent (and numbered 1 and 2 in said application) in determining the meaning of the word "vaporization" as used in said patent.

5. The District Court erred in rejecting the following evidence of Dr. George Granger Brown (appearing at pages 4204-7 of the Transcript (*infra*, 1366-7) and taken under the provisions of Rule 43-c):

"Mr. Hall: Q. Mr. Smith starting at page 3161 of the record; testified: 'In defendant's vapor separator there is a foamy or frothy mass of liquid extending for a number of feet up into the separator. This is brought about by the high velocity of the stream of material entering the vapor separator which enters very close to the bottom of the separator, and this serves to agitate and stir up this small amount of liquid in there into this foamy mass.

'Now if "vaporization" includes the separating step, or if "vaporization" is the separating step, that takes place up in the vapor separator some distance from the bottom, and the residue, however, is drawn off from the bottom very near where the stream enters the separator.

'Now if vaporization does not take place until you get up here in the upper portion of the separator, above the foam or froth, then it seems to me that you would necessarily conclude that residue is withdrawn before separation because the residue is withdrawn from the bottom very near the inlet. Now that does not make sense to me but

5768 that is what I am led to if I include the separating step as a necessary part of the vaporization or if I say that vaporization is the separating step.'

Now do you agree with Mr. Smith's conclusion which he has reached from the facts he has stated; and if you do not, will you give your reasons?

Mr. Von Holst: I object to the question.

The Court: The objection will be sustained.

Mr. Hall: May I take that one under the [illegible], if your Honor please?

The Court: All right. There is no way to get it in except by having the witness state it.

Mr. Hall: Q. Now you will have to answer that.

A. No. It is true that the 'vaporization', meaning the liberation of vapors to form a continuous vapor phase, takes place in the upper part of the vapor separator in defendant's operation, this vaporization or vapor space exists in defendant's operation above the stream which is the stream of liquid which is removed from the bottom of the vapor separator after the vapor has been liberated or has freed itself from entrainment within this liquid stream. In so far as the liquid residue is removed from the vapor separator prior to the liberation of the vapors, to that extent the efficiency of the vapor separator is impaired because it would include with the residue some of the reflux condensate and also the final product which is desired in the pressure distallate."

6. The District Court erred in failing to find that the defendant's accused process infringes said Dubbs patent in suit.

5769 7. The District Court erred in failing to find that the process described in Egloff patent 1,537,593 is useful and beneficial in the cracking of oil, and in failing to find that the process of said Egloff patent has been used commercially.

8. The District Court erred in failing to find that the said Egloff patent involved invention and in holding said patent invalid.

9. The District Court erred in failing to find that defendant's accused process infringed said Egloff patent.

10. The District Court erred in entering judgment for the defendant with costs, and in dismissing the complaint.

(Sgd.) Alexander F. Reichmann,
Attorney for Plaintiff

March 26, 1942.

5770 BOND ON APPEAL. Filed Nov. 7, 1941.

(Filed Nov. 7, 1941. Hoyt King, Clerk.)

Know All Men By These Presents:

That we, Universal Oil Products Company, as principal, and Fireman's Fund Indemnity Co. as sureties, are held and firmly bound unto Globe Oil & Refining Company in the full and just sum of Two Hundred Fifty ($250.00) Dollars, to be paid to the said Globe Oil & Refining Company, its attorneys, executors, administrators, or assigns; to which payment, well and truly to be made, we bind ourselves, our heirs, executors, and administrators, jointly and severally, firmly by these presents.

Sealed with our seals and dated this 7th day of November, in the year of our Lord one thousand nine hundred and forty-one.

Whereas, lately at a session of the District Court of the United States for the Northern District of Illinois, Eastern Division, in a suit pending in said Court between Universal Oil Products Company, plaintiff, and Globe Oil & Refining Company, defendant, a decree was rendered against the said Universal Oil Products Company dismissing its Complaint, and the said Universal Oil Products Company having filed a notice of Appeal to the United States Circuit Court of Appeals for the Seventh Circuit, to reverse the decree of the aforesaid suit.

Now, the condition of the above obligation is such, that if the said Universal Oil Products Company shall prosecute its said appeal to effect, and shall answer all damages and costs that may be awarded against it, if it fails to make its plea good, then the above obligation to be void; otherwise to remain in full force and virtue.

Sealed and Delivered in Presence of:

Universal Oil Products Company,
By J. G. Althen (Sgd.) (Seal)
Its Vice President.

Attest:
W. M. Behrens (sgd.)

Approved by:
Fireman's Fund Indemnity Co.,
D. J. Cronkhite (sgd.)
Attorney in Fact.

5771 Stipulation:

By stipulations duly filed and approved by the District Court, the time of the plaintiff for filing the record on appeal was extended to February 5, 1942. On January 12, 1942 a designation of the contents of a short record on appeal was filed and on January 21, 1942 there was filed an order of the Circuit Court of Appeals extending to April 6, 1942 the time for filing the complete record on appeal.

5772 The following stipulation heretofore agreed to on behalf of plaintiff and defendant:

The issue of res adjudicata will not be raised on this appeal from the judgment of the District Court entered October 14, 1941.

5774 STIPULATED DESIGNATION OF CONTENTS OF RECORD OF APPEAL.

The parties hereby stipulate, in accordance with Civil Rule 75 (f), the following portions of the record, proceedings and evidence to be contained in the record on the appeal of which plaintiff has heretofore given notice herein:

1. Caption (in usual form).
2. Docket entries.
3. Original bill of complaint filed July 22, 1931.
4. The following stipulation heretofore agreed to on behalf of the plaintiff and the defendant, Globe Oil and Refining Company:

No process was served on Winkler-Koch Engineering Company and no appearance was entered in its behalf. The word "defendant", as herein used, means only the Globe Oil and Refining Company, an Illinois Corporation.

5. Answer of defendant filed March 2, 1932.

5775 6. The following stipulation heretofore agreed to on behalf of plaintiff and defendant:

On October 13, 1936 a bill in the nature of a supplemental bill was filed by Universal Oil Products Company, a Delaware Corporation, the effect of which was to substitute said Universal Oil Products Company (Delaware) for the original plaintiff, Universal Oil Products Company, a South Dakota corporation. The complaint alleged inter alia that Universal Oil Products Company (South Dakota) had assigned the patents in suit and all rights

of action thereunder to Universal Oil Products Company (Delaware) on January 14, 1936. On September 23, 1936 Globe Oil and Refining Company filed its answer thereto, pleading no knowledge as to the alleged facts just stated.

7. Amendment to defendant's answer, filed May 11, 1937.

8. Motion to dismiss bill, etc. filed January 4, 1938 (omitting the supporting affidavit of J. B. Thiess).

9. Transcript of pages 1 to 11, 25 and 43 to 50 inclusive of the proceedings on defendant's motion to dismiss the complaint for unclean hands.

10. Amendment to answer filed January 5, 1938.

11. Petitions for subpoenas duces tecum to Otto Behimer and plaintiff filed January 5, 1938.

12. The following stipulation heretofore agreed to on behalf of plaintiff and defendant:

On January 5, 1938 an order to issue subpoena duces tecum to Otto Behimer as prayed in the aforesaid petition was issued, the subpoena issued thereon on the same day and was duly served and the said Otto Behimer appeared in response thereto.

Hearing on defendant's motion for subpoena duces tecum to the plaintiff was had on January 12, 1938, and the motion was denied upon assurance of plaintiff's counsel that a search would be made for the designated documents, and that the same would be produced upon the hearing of the issue of unclean hands subject to questions of materiality and relevancy.

5776 13. Interrogatories filed by defendant on January 14, 1938.

14. The following stipulation heretofore agreed to on behalf of plaintiff and defendant:

The hearing on defendant's application for leave to file interrogatories was had on January 14, 1938, and the Court then and there, because of plaintiff's opposition, denied all save the first five interrogatories. The Court ruled: "I am not going to require answers to interrogatories on things that you are going to examine the witnesses about."

15. Plaintiff's answers to interrogatories 1 to 5 inclusive.

16. Amendment to defendant's answer, filed Feb. 9, 1938.

17. Defendant's motion for order to produce records, filed June 2, 1938.

18. Defendant's petition for subpoena duces tecum to Maurice Beyt.

19. Opinion of the District Court on defense of unclean hands (delivered orally) together with findings of fact and conclusions of law entered thereon.

20. Order denying defendant's motion to dismiss for unclean hands.

21. Amendment to defendant's answer, filed Jan. 4, 1940.

22. Motion of defendant for re-admitting into evidence DX 816 (for identification).

23. Opinion of the District Court filed July 24, 1941 together with findings of fact and conclusions of law entered thereon.

24. Final judgment.

25. Notice of appeal.

26. Bond on Appeal.

5777 27. The following stipulation heretofore agreed to on behalf of plaintiff and defendant:

By stipulations duly filed and approved by the District Court, the time of the plaintiff for filing the record on appeal was extended to February 5, 1942. On January 12, 1942 a designation of the contents of a short record on appeal was filed and on January 21, 1942 there was filed an order of the Circuit Court of Appeals extending to April 6, 1942 the time for filing the complete record on appeal.

28. Plaintiff's designation of points on appeal.

29. The following stipulation heretofore agreed to on behalf of plaintiff and defendant:

The issue of res adjudicata will not be raised on this appeal from the judgment of the District Court entered October 14, 1941.

30. This stipulation.

31. Transcript of the testimony taken in the District Court on April 12-15, June 1-3 and 7-9, 1938 on defendant's motion to dismiss for unclean hands.

32. Testimony of R. J. Dunham; L. A. O'Shaughnessy; David Phillip Hamilton; William Henry Lamprecht II; Henry F. Heil; and Fred C. Koch; together with statements of counsel at pages 337 to 344 of the transcript of July 6, 1938; as abstracted and filed herewith.

33. Transcript of the testimony taken at final hearing, beginning May 8, 1940 and ending June 24, 1940.

34. The following exhibits (all exhibits, whether plain-

tiff's or defendant's, are designated by number. The prefix PX indicates a plaintiff's exhibit and the prefix DX indicates a defendant's exhibit):

PX-B (Dearborn Deposition)
PX-77
PX-78
PX-81
PX-82
PX-83
PX-116
PX-120
5778 DX-163 (a to m incl.)
DX-164
DX-173 (a to K incl.)
DX-174 (a to q incl.)
DX-175 to DX-197 inclusive
DX-202 to DX-249 inclusive
DX-307
DX-308
DX-311
PX-500 to PX-524 inclusive
DX-525 to DX-530 inclusive
PX-532 to PX-552 inclusive
DX-554 to DX-559 inclusive
DX-561 to DX-565 inclusive
PX-566 to PX-587 inclusive
DX-588 to DX-593 inclusive
DX-595
DX-596
PX-597
PX-598
DX-599 to DX-622 inclusive
DX-623a
DX-626 to DX-630 inclusive
DX-632
DX-634
DX-635
PX-636 to PX-638 inclusive
DX-641
DX-642
DX-644 to DX-658 inclusive
~~DX-660~~
DX-662 to DX-740 inclusive
DX-746
DX-747

DX-750 to DX-765 inclusive
DX-769
DX-772 to DX-828 inclusive
PX-829
PX-830
DX-831 to DX-835 inclusive
PX-836 to PX-848 inclusive
DX-849
DX-850
DX-851

(Sgd.) Walter J. Blenko,
Attorney for Plaintiff.

(Sgd.) J. Bernhard Thiess,
Attorney for Defendant.

March 23, 1942.

5779 AGREED STATEMENT AS TO EXHIBITS.

In this record the exhibits are identified by number. The preface "PX" indicates a plaintiff's exhibit and the preface "DX" a defendant's exhibit. All exhibits included in the offered record were duly offered and received in evidence, except where referred to as "for identification" in which case they are included in the record under the provisions of Civil Rule 43 (c).

5780 31. Stipulated abstract of testimony taken in the District Court on April 12-15, June 1-3 and 7-9, 1938 on defendant's motion to dismiss for unclean hands.

(Filed herewith in separate volume, Vol. II.)

5781 34. The following exhibits are to be printed, or otherwise reproduced, omitting all unnecessary captions but otherwise complete, except as indicated (the exhibits, whether plaintiff's or defendant's are designated by number. The prefix PX indicates a plaintiff's exhibit and the prefix DX indicates a defendant's exhibit):

PX B (in Dearborn deposition).

Abstract of DX 163 (a-m), DX 164, DX 173 (a-k), DX 174 (a-q).

The following is a list of the patent infringement suits instituted against users of Winkler-Koch stills, who contributed to the defense fund, showing the Court in which the case was filed, the date of the filing of the Bill of Complaint, and the number of patents involved:

Universal Oil Products Company *vs.* White Eagle Oil & Refining Co. (District of Del.) Filed March 11, 1929 Equity No. 717 6 patents.

Universal Oil Products Company *vs.* Globe Oil & Refining Co. (District of Del.) Filed April 11, 1930. Equity No. 784 8 patents.

Universal Oil Products Company *vs.* Skelly Oil Company, (District of Del.) Filed April 11, 1930. Equity No. 785 6 patents.

Universal Oil Products Company *vs.* Globe Oil & Refining Co. (District of Del.) Filed July 7, 1931 Equity No. 892 2 patents.

5782 Universal Oil Products Company *vs.* Skelly Oil Co. (District of Del.) Filed July 7, 1931 Equity No. 893 4 patents.

Universal Oil Products Company *vs.* White Eagle Oil & Refining Co. (District of Del.) Filed July 7, 1931 Equity No. 894 4 patents.

Universal Oil Products Company *vs.* Anderson Prichard Oil Company (Western District of Okla.) Filed August 23, 1934 Equity No. 1645 4 patents.

Universal Oil Products Company *vs.* Omar Refining Company (Western District of Okla.) Filed August 21, 1935 Equity No. 1779 2 patents.

Universal Oil Products Company *vs.* Rock Island Refining Company (Eastern District of Okla.) Filed August 23, 1934 Equity No. 4559 5 patents.

Universal Oil Products Company *vs.* Eldorado Refining Company (District of Kans.) Filed July 23, 1934 Equity No. 819-N 6 patents.

Universal Oil Products Company *vs.* Globe Oil & Refining Co. (District of Kans.) Filed July 25, 1935 Equity No. 821-N 5 patents.

Universal Oil Products Company *vs.* National Refining Co. (Northern District of Ohio) Filed September 30, 1931 Equity No. 4018 10 patents. (Dismissed January 8, 1935.)

Universal Oil Products Company *vs.* National Refining Co. (District of Kans.) Filed April 1, 1935 Equity No. 449-N 3 patents.

Universal Oil Products Company *vs.* National Refining Co. (District of Kans.) Filed March 25, 1937 Equity No. 473-N 2 patents.

Gasoline Products Company, Inc. *vs.* Skelly Oil Co. (District of Kans.) Filed August 8, 1929 Equity No. 557-N 3 patents.

Gasoline Products Company, Inc. *vs.* Globe Oil & Refining Co. (Western District of Okla.) Filed July 19, 1935 Equity No. 1762 1 patent.

5783 Gasoline Products Company, Inc. *vs.* Champlin Refining Company (District of New Mexico), Filed March 18, 1933 Equity No. 2581 3 patents.

Gasoline Products Company, Inc. *vs.* Globe Oil & Refining Company (Western Dist. of Okla.) Filed Dec. 26, 1933 Equity No. 1567 4 patents.

Gasoline Products Company, Inc. *vs.* National Refining Company (Northern Dist. of Ohio) Filed Dec. 28, 1933 Equity No. 1398 3 patents.

Gasoline Products Company, Inc. *vs.* Skelly Oil Company (Dist. of Kansas) Filed Oct. 22, 1932 Equity No. 725-N 2 patents.

The Texas Company *vs.* Anderson Prichard Refining Corporation (Western District of Okla.) Filed May 5, 1933 Equity No. 1485 2 patents.

The Texas Company *vs.* Chalmette Petroleum Corporation (Eastern Dist. of La.) Filed Apr. 6, 1933 Equity No. 135 2 patents.

The Texas Company *vs.* The Republic Oil Refining Company (Southern District of Texas) Filed March 4, 1933 Equity No. 557 6 patents.

The Texas Company *vs.* Garber Refining Company (Western Dist. of Okla.) Filed March 6, 1933 Equity No. 1456 6 patents.

The Texas Company *vs.* Eldorado Refining Company (Dist. of Kansas) Filed June 29, 1935 Equity No. 863-N 2 patents.

5784 The Texas Company *vs.* Champlin Refining Company (Western Dist. of Okla.) Filed March 1, 1937 Equity No. 1939 2 patents.

Standard Oil Company *vs.* Globe Oil & Refining Company (Dist. of Kansas) Filed Dec. 30, 1933 Equity No. 796-N 3 patents.

Standard Oil Company *vs.* Rock Island Refining Company (Eastern Dist. of Okla.) Filed Jan. 10, 1933 Equity No. 4462 3 patents.

Standard Oil Company *vs.* Globe Oil & Refining Company (Northern Dist. of Ill.) Filed Aug. 10, 1931 Equity No. 10770 2 patents.

Standard Oil Company *vs.* Globe Oil & Refining Company (Northern Dist. of Ill.) Filed Nov. 4, 1932 Equity No. 12593 1 patent.

5785 DX 175 Pages B and C only.

DX 176 The following portions only:

Certificate;

Paper No. ~~33~~, remarks only;

Paper No. 45, in full;

Paper No. 55, heading from page 1; p. 16, first full paragraph, all of p. 17, down to end of first paragraph on p. 18; first paragraph of p. 19; first full paragraph of p. 23, ending on p. 24;

Notice of Allowance.

DX 177 The following portions only:

Certificate;

Paper No. 1; petition, specification including claims, drawings, and oaths;

Paper No. 2, in full;

Paper No. 11, remarks only;

Paper No. 13, in full;

Paper No. 17, in full;

Notice of allowance.

DX 178 The following portions only:

Certificate;

Pages 1-4, inclusive, 7a, 8, 16-23 inclusive, 26-42 inclusive, 45, 51, 52, excepting last seven lines; 66, bottom paragraph 67; 111-126 inclusive, 128, 129.

Agreed statement:

"Seven stipulations extending time for taking testimony were thereafter filed and approved by the Patent Office."

Pages 154, 155 and 156 to end of paragraph (f); 160, signature and date only; 167; 172; 189-192 to end of paragraph 9; 195, signature only; 208; 209; 272-276; 278.

Agreed statement:

"Eighteen agreed suspensions of further proceedings were granted by the Patent Office, the first 15 in view of the pendency of other related interferences and the remaining 3 in view of pending negotiations for settlement."

5786 Pages 321; 323, 331, 333-337 inclusive.

DX 179 The following portions only:

Certificate;

Paper Nos. 1-5, inclusive, in full;

Paper No. 12, in full, including affidavit of Dearborn;

Paper No. 14, the Dearborn letter only;

Papers Nos. 15-18, inclusive, in full;

Paper Nos. 21 and 22, in full;
Paper No. 25, in full;
Paper No. 28, in full;
Paper No. 29, in full;
Paper Nos. 31 and 32, in full.

DX 202 Reproduce only the check attached to the exhibit.

DX 203 Reproduce only the letter and envelope attached to the exhibit.

DX 206 Reproduce only the following:

Certificate;

Paper No. 1, in full, including petition, specification, claims, drawings and oath;

Paper No. 8, in full;

Paper No. 9, first page, except last paragraph; second page, beginning "Add the following claims," to end of paper;

Paper No. 12, in full;

Paper No. 13, in full, including affidavit and drawing;

Paper Nos. 14, 15 and 16, in full;

Paper No. 21, in full;

Paper No. 31, in full with attached summary;

Notice of Allowance.

5787 DX 208 Reproduce only the following:

Title page; pages 38 to 51, inclusive; 54; 55; 65 to 68, inclusive; and 80 to 85, inclusive.

DX 209 Reproduce the last letter only.

DX 210 Preface this exhibit with the following statement:

The italicized portion of this exhibit was offered and is included in the appeal record under the provisions of Rule 43 (c). [Note: Pages 2 and 3, and the first line of page 4, up to the period, are to be printed in italics.]

DX 212 to DX 217 inclusive.

DX 219.

DX 220 In lieu of this exhibit print the following:

Agreed statement as to DX 220:

"This exhibit is a certified copy of bill of complaint filed in the United States District Court for the District of Kansas on July 25, 1934, and amended bill of complaint filed August 10, 1934, and supplemental bill filed April 28, 1936, by the Universal Oil Products Company, plaintiff, *vs.* The Dickey Refining Co. (a Texas Company licensee), defendant, Equity No. 822N, wherein the plaintiff charged infringement of the Dubbs patent No. 1,392,629 and other

patents by the defendant; and certified copy of answer filed by said defendant on July 21, 1936, wherein Otto Behimer was set up as the prior inventor of the subject matter of the Dubbs 1,392,629 patent."

DX 234.
DX 235.
DX 236 (a, b and c).
DX 237.
DX 239.
DX 240.

DX 241 Preface this exhibit with the following statement:

This exhibit was offered and is included in the appeal record under the provisions of Rule 43 (c).

5788 DX 242 to DX 245 inclusive.

Print the following in lieu of these exhibits:

Agreed statement:

"DX 242 is a certified copy of bill of complaint filed in United States District Court for the Northern District of Illinois, Eastern Division, on January 26, 1926, Equity No. 5560, by the Universal Oil Products Company, plaintiff, *vs.* The Texas Company, defendant, wherein plaintiff alleged infringement by defendant of the Dubbs 1,392,629 patent, among others."

"DX 243 is a certified copy of the answer of The Texas Company, filed June 30, 1927, in the case of Universal Oil Products Company *vs.* The Texas Company, Equity No. 5560, wherein, among other defenses, Otto Behimer was set up as the prior inventor of the subject matter of the Dubbs 1,392,629 patent."

"DX 244 is a certified copy of bill of complaint filed in United States District Court for the Northern District of Indiana, on January 28, 1926, Equity No. 33, by the Universal Oil Products Company, plaintiff, *vs.* Standard Oil Company (Indiana), defendant, wherein plaintiff alleged infringement by defendant of the Dubbs 1,392,629 patent, among others."

"DX 245a and DX 245b are certified copies of paragraph XXX and the first counterclaim of the answer and counterclaim filed May 16, 1927, and of the amendment to answer filed July 12, 1927 in the case of Universal Oil Products Company *vs.* Standard Oil Company (Indiana), Equity No. 33, wherein Otto Behimer was set up as the prior inventor of the subject matter of the Dubbs 1,392,629 patent,

and wherein defendant, by way of counterclaim, prayed that Otto Behimer be adjudged to be the first, original and sole inventor of the subject matter of the Dubbs 1,392,629 patent, and that said 1,392,629 patent be declared null and void."

DX 246.

DX 247 Omit the letter dated August 16, 1925.

DX 249 [Note: There were two exhibits so numbered. The one which is to be printed consists of correspondence between C. P. Dubbs and Otto Wannack. See attached copy.]

5814 DX 307, DX 308, DX 311.

PX 500, PX 501, PX 502, PX 503, PX 504, PX 505a, PX 506, PX 507, PX 508, PX 509, PX 510, PX 513, PX 514, PX 515, PX 516, PX 519, PX 520, PX 521 (a, b and c), PX 522, PX 523, PX 524.

DX 525, DX 526, DX 527, DX 528, DX 529, DX 530.

PX 532, PX 535, PX 536, PX 537, PX 538, PX 550, PX 551a, PX 551b.

PX 552 The following portions only:

Certificate;

Petition and specification, comprising pages 2-17;

Drawing, comprising page 160.

DX 554, DX 555, DX 559, DX 561.

PX 566, PX 567, PX 568, PX 577, PX 579 (a, b and c), PX 580 (580 and 580a to 580f, inclusive), PX 582, PX 583, PX 584, PX 585, PX 586, PX 587.

DX 588, DX 589.

DX 590, DX 591, DX 592, Print the following in lieu of these three exhibits:

5815 DX 593, DX 595, DX 596,

PX 597, PX 598,

DX 599, DX 604, DX 605, DX 621, DX 623a, DX 627,

DX 628. The following portions only:

Title, pages 5-7, except last two lines, first and second full paragraphs of page 9, pages 11-15, inclusive, pages 20-23 inclusive, top 21 lines page 24, last five lines page 28, top 13 lines page 29, pages 39 and 40 in full.

DX 634, DX 635, omitting attached summaries.

PX 637, PX 638,

DX 641, DX 642,

DX 644 to DX 647 inclusive,

5816 DX 648. Print the following excerpt:

First Principles of Physical Science, by David A. Wells (1863), at p. 194:

"1284. What is meant by vaporization?

"The conversion of a solid or liquid into vapor; as snow or water is converted into vapor by the heat of the sun."

DX-649. Print the following excerpt:

Physics for College Students, by Henry S. Carhart (1910), at p. 375:

"Vaporization.—Vaporization is the transition of a substance from the solid or the liquid state into that of a gas. There are four distinct forms of vaporization, depending on the conditions under which the transition occurs:

"1. Evaporization, in which a liquid is converted into a vapor at its free surface at a relatively low temperature, and without the formation of bubbles.

"2. Ebullition, or boiling, a rapid evaporation at a higher thermal equilibrium, when the liquid is visibly agitated by internal evaporation.

"3. Spheroidal state, in which quiet evaporation, at a lower rate than boiling, goes on with the vapor acting as a cushion between the liquid and a surface at a relatively high temperature.

"4. Sublimation, in which a solid passes directly into the gaseous form without passing through the intermediate liquid state.

"Whether the gaseous condition is reached by one of these processes or another, heat is always absorbed, although the vapor formed is at the same temperature as the solid or the liquid from which it comes. The heat absorbed in the transition into the form of a gas is called the heat of vaporization."

5817 DX-650. Print the following excerpt:

A Text-Book of Physics, by Louis Bevier Spinney (1925), at p. 196:

"If water is placed in an open vessel in a room at ordinary temperature it will be observed to gradually disappear from the vessel. This escape of the liquid by passing into the vapor state, a change which takes place wholly at the surface of the liquid is called Evaporation. If the water is heated until it comes to the temperature known as the boiling point, vapor will begin to form in bubbles within the body of the liquid itself. These bubbles of vapor rise to the top, expanding as they rise into regions of diminished pressure, bursting at the surface and setting free large quantities of the vapor. This formation of vapor within the liquid is known as ebullition, or boiling.

"The boiling point of a liquid may therefore be defined as that temperature at which the bubbles of vapor are

formed within the liquid. Evidently this formation of vapor is one kind of vaporization, but it is distinguished from the process of evaporation by the fact that the vapor is formed within the liquid."

DX-651. Print the following excerpt:

Physics, Advanced Course, by George F. Barker (1892), at p. 309:

"Vaporization of Liquids.—The process of converting a liquid into a vapor is also called vaporization. The production of vapor may take place solely from the surface of the liquid, or it may take place throughout its mass. In the former case the vaporization is effected by evaporation; in the latter, by ebullition."

DX-652. Print the following excerpt:

Elementary Treatise on Physics, Experimental and Applied, by E. Atkinson (1879), at p. 278:

"Vaporisation.—The passage of a liquid into the gaseous state is designated by the general term vaporisation; the term evaporation especially refers to the slow production of vapour at the free surface of a liquid, and boiling to its rapid production in the mass of the liquid itself."

5818 DX-653. Print the following excerpt:

Essentials of Physics for College Students, by Daniel W. Hering (1912), at p. 115:

"* * * The change of a liquid into the gaseous state is vaporization.

* * * * * * *

"There are three processes of vaporization: (1) evaporation, where a liquid is converted into a gas quietly and without formation of bubbles; (2) ebullition, where bubbles of gas are formed in the mass of the liquid itself; (3) vaporization in the spheroidal state, where a liquid evaporates slowly, although apparently in contact with a very hot substance."

DX-654. Print the following excerpt:

College Physics, by John Owen Reed and Karl Eugen Guthe (1912), at p. 240:

"Vaporization is the process of transforming a substance from the solid or the liquid state into the gaseous state."

DX-655. Print the following excerpt:

The Elements of Physics, by S. E. Coleman (1906), at p. 192:

"The change of a substance from the solid or liquid to the gaseous state is called vaporization. Vaporization may

take place at the free surface of a liquid, or within its mass at the place where heat is applied. In the first case the phenomenon is generally called evaporization; in the second case, boiling."

DX-656. Print the following excerpt:

The Elements of Physics, by Henry S. Carhart and Horatio N. Chute (1894), at p. 148:

"Vaporization is the act of changing a substance into a gaseous condition. If this change takes place slowly, without producing any noticeable disturbance in the body of the substance, it is called Evaporation. If, during the act, the body is visibly agitated, it is called Ebullition."

5819 DX-657. Print the following excerpt:

Physics for Students of Applied Science, by J. Edmond Shrader (1937), at pp. 198, 202:

"Change of State.—When heat is supplied to substances the following physical changes may take place

"1. Fusion or melting, a change from the solid to the liquid state. The reverse change is solidification, or freezing.

"2. Vaporization, a change from a liquid to a vapor. The reverse change is condensation.

"3. Sublimation, a change from the solid state directly to the vapor state. The reverse change is condensation.

"Vaporization.—Vaporization is the process of changing from a liquid to a gaseous state. Vaporization may take place under two conditions: If vapor is formed only at the surface, it is called evaporation; if vapor is formed within the body of the liquid, the process is called ebullition, or boiling. The amount of heat necessary to change 1 gm. of a liquid at its boiling point into vapor at the same temperature is called its latent heat of vaporization."

DX-658. Print the following excerpt:

A Textbook of Inorganic Chemistry for Colleges, by James F. Norris (1921), at p. 163:

"The conversion of a gas into a liquid is the process opposite to that of vaporization; it is called condensation. In this case heat is set free, the amount being equal to that absorbed in vaporization."

DX-660, DX-662 to DX-669 inclusive.

DX-671 to DX-673 inclusive.

5820 DX-674 Print the following excerpt:

(p. 2) Physics in Everyday Life, by William D. Henderson (1921), at p. 215:

"The process by which a substance changes to a vapor is called vaporization. It may take place by boiling, by evaporation, or by sublimation."

(p. 4) A Text-Book in Physics, by William N. Mumper (1907), at p. 198:

"* * * Most liquids may be converted into the gaseous or vapor state by the addition of heat. This change of state, without regard to the conditions under which it occurs, is called vaporization."

(p. 5) Mechanics and Heat, by William B. Anderson (1914), at p. 260:

"Vaporization Defined.—Vaporization is the general term applied to the process of changing from a liquid or solid to the vapor state. Vaporization takes place in three different ways, evaporation, ebullition (Sec. 192), and sublimation. * * *

"In whatever manner the vaporization occurs, it requires heat energy to bring it about, and when the vapor condenses an equal amount of heat (the heat of vaporization, Sec. 182) is evolved."

(p. 6) General Physics and Its Application to Industry and Everyday Life, by Ervin S. Ferry (1921), at p. 268:

"* * * The conversion of a liquid or solid into vapor is termed vaporization. Four different sorts of vaporization can be distinguished. These are evaporation, sublimation, boiling and the spheroidal state."

5821 DX-675 to DX-680 inclusive.

DX-685 to DX-687 inclusive.

DX-689, D-691 to DX-693 inclusive.

DX-695 to DX-697 inclusive, DX-699, DX-703, DX-704.

DX-705 Reproduce only the first page, heading only, and the last three pages.

DX-706 Reproduce only the first page, heading only, and the last five pages.

DX-707 Reproduce only the first page, heading only, and the last three pages.

DX-708 Reproduce only the first page, heading only, and the last two pages.

DX-709, DX-710 (a, b and c).

DX-711 Reproduce only the first page, heading only, and the last four pages.

DX-715, DX-723 to DX-733 inclusive.

DX-734. Preface this exhibit with the following statement:

This exhibit was offered and is included in the appeal record under the provisions of Rule 43 (c).

DX-746 (a to o):

DX-752, DX-754, DX-755.

DX-756 Omitting the drawing.

DX-758, DX-759 omitting the documents attached to the letter.

DX-760, DX-761, DX-762, DX-773, DX-774a.

DX-775 to DX-801 inclusive.

DX-802 and DX-802a—Reproduce the following portions only:

Certificate;

Original petition, specification, claims, oath and drawings;

Paper No. 2, in full;

Paper No. 3, p. 1; first 7 lines p. 2; last 4 lines p. 3; p. 4 in full;

Paper No. 5, first 15 lines p. 1; last paragraph p. 3, to and including the third full paragraph on p. 4; second paragraph p. 5; second paragraph p. 6; first and second paragraphs p. 7; and signature on p. 9;

Notice of Allowance.

5822 DX-803 to DX-806 inclusive.

DX-807 The following portions only:

Certificate;

Petition, original specification, claims 8, 11, 12, 14 and 16, oath and drawings;

Notice of Allowance.

DX-808, DX-809.

DX-810 The following portions only:

Certificate;

Original petition, specification, claims, oath and drawing;

Paper No. 2, p. 1 in full; signature from p. 3;

Paper No. 4, last 3 lines, p. 1; last paragraph p. 2; top 16 lines p. 3; signature on p. 4;

Paper No. 6 in full, including drawings;

Paper No. 21, heading from p. 1; claim 17 from p. 3;

Notice of Allowance;

Paper No. 36 in full;

Paper No. 37 in full.

DX-811 to DX-815 inclusive.

DX-816 Preface this exhibit with the following statement;

This exhibit was offered and is included in the appeal record under the provisions of Rule 43 (c).

Print the following portions only:

Certificate;

Original petition, p. 2;

Specification in full, including drawings; oath p. 15; p. 24; p. 45 omitting last 6 lines; claims 5 and 6 on pp. 47-8; p. 52, first and second full paragraphs; p. 53, signature only.

DX-817.

DX-818 (a to o).

5823 DX-819 The following portions only:

Title, last line on first column of second page; first paragraph of second column on second page; publisher's name at bottom of fourth page.

DX-820 Print title, and paragraph 1 only.

DX-821 Print title, paragraphs 1 and (d) only.

DX-822 to DX-824 inclusive.

DX-825 Print the following excerpt:

Principles of Chemical Engineering, by William H. Walker, Warren K. Lewis and William H. McAdams (1923), at pp. 381, 478:

"If the liquid is in a space in which the partial pressure of its vapor is less than the vapor pressure it possesses at this temperature, it will proceed to vaporize and its vapor will pass into space. But this change of state is accompanied by the large absorption of heat already noted. If this heat be not supplied from some external source, vaporization will nevertheless continue, and the necessary heat will be taken from the sensible heat of the liquid, with a consequent reduction of temperature. This fall in temperature of the liquid is accompanied by a corresponding decrease in vapor pressure. Finally a temperature is reached where the vapor pressure of the liquid is equal to its partial pressure existing in the space and vaporization will cease.

"Therefore, in order for vaporization to continue, two conditions must be met:

"First—the heat necessary for vaporization must be continuously supplied.

"Second—the equilibrium which forms between the

vapor pressure of the liquid and its partial pressure in the surrounding space must be continuously destroyed.

"If either one of these two conditions be neglected vaporization will be retarded or even stopped.

"By far the most important processes for drying liquids and solids depend upon first vaporizing the water and in this form separating it from the structure of which it formed a part."

5824 DX-826a and DX-826b.

The following portions only:

Certificate; title to brief from p. 199; last four lines of p. 208; top 7 lines of p. 209; and signature on p. 220.

DX-827a.

DX-828 The following portions only:

Title, interrogatory 1, and signature, title of the answer, answer to interrogatory 1, signature and oath.

PX-829, PX-830.

DX-831 to DX-835 inclusive.

PX-836 to PX-839 inclusive.

PX-841 to PX-848 inclusive.

DX-849, DX-850.

PX-851.

IN THE UNITED STATES CIRCUIT COURT OF APPEALS

Filed Mar. 24, 1942.

For the Seventh Circuit.

Universal Oil Products Company,
Plaintiff-Appellant,
vs.
Globe Oil & Refining Company,
Defendant-Appellee.
} No. 7912.

STIPULATION.

Whereas the trial in the District Court consumed more than 30 days, and the stenographic transcript of proceedings in the District Court is approximately 6000 pages, and the parties have introduced in evidence in excess of 500 exhibits, and

Whereas at the direction of the District Court, and for its convenience and use, the parties abstracted and condensed much of the testimony and documentary exhibits and

Whereas the parties are now cooperating in preparing further abstracts and abridgments of the balance of the testimony and many of the documentary exhibits, and have agreed upon an abstract of the pleadings, testimony, and exhibits upon which the above entitled appeal may be heard and considered by this court,

It Is Hereby Stipulated and Agreed by and between the parties, by their respective counsel, that the certified transcript of record on appeal to be lodged in this court shall contain and consist of the pleadings, orders, opinions, etc., the full and complete stenographic transcript of proceedings in the District Court, and the exhibits, all as called for and designated by the parties in the stipulated designation of the record to be filed with the Clerk of the United States District Court, but that, this Honorable Court consenting, the same shall not be printed as such in this Court and that, on the contrary, the printed record on appeal may only embody and consist of the agreed abstract of pleadings, testimony, and exhibits as prepared and stipulated by the parties and to be filed concurrently by the parties with the certified transcript of record on appeal, it being understood that reference may be had to the certified transcript of record on appeal in the event of error as to the matters appearing in the printed agreed record.

Alexander H. Reichmann,
Attorney for Plaintiff-Appellant.

J. Bernhard Thiess,
Attorney for Defendant-Appellee.

The foregoing stipulation is approved.

Evan A. Evans,
United States Circuit Judge.

(Endorsed) In the United States Circuit Court of Appeals * * (Caption—7912) * * Stipulation Filed Mar 24, 1942 Kenneth J. Carrick, Clerk.

UNITED STATES CIRCUIT COURT OF APPEALS

For the Seventh Circuit.

I, Kenneth J. Carrick, Clerk of the United States Circuit Court of Appeals for the Seventh Circuit, do hereby certify that the foregoing printed pages contain a true copy of Volume 6 of the printed record, printed under my supervision, which, together with Volumes 1 to 5 and Volume 7, constitutes the record upon which the following entitled cause was heard and determined:

Cause No. 7912.

Universal Oil Products Company,
Plaintiff-Appellant.

vs.

Globe Oil & Refining Company,
Defendant-Appellee,

as the same remains upon the files and records of the United States Circuit Court of Appeals for the Seventh Circuit.

In Testimony Whereof I hereunto subscribe my name and affix the seal of said United States Circuit Court of Appeals for the Seventh Circuit, at the City of Chicago, this 18th day of August, A. D. 1943.

Kenneth J. Carrick,
(Seal) *Clerk of the United States Circuit Court of Appeals for the Seventh Circuit.*